MEASURING AND ANALYSING THE IMPACTS OF TRAVEL DEMAND MANAGEMENT INTERVENTIONS ON COMMUTER TRAVEL BEHAVIOUR: The case of rail-based park-and-ride facilities in Cape Town

By

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DECLARATION

I hereby declare that this dissertation submitted for the Master of Philosophy in Transport Studies degree, at the University of Cape Town is my own original work and has not previously been submitted to any other institution of higher education. I further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references.

J.A. van Rensburg

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ABSTRACT

This dissertation reports upon the findings of a study undertaken in Cape Town to measure the impacts of park-and-ride facility upgrades on commuting behaviour at selected rail stations.

The study analysed data from two sources covering the period before and after park-and-ride facility upgrades at three affected rail stations (Brackenfell, Kraaifontein and Kuilsrivier) and three control stations. The purpose of including the control group was to assist in assessing whether any utilisation changes observed across the before and after periods were the result of external factors. The first data source took the form of parking counts and vehicle number plate recordings (n=6,501) over a period of 12 months. The second took the form of an (n=400) intercept survey of park-and-ride users at the affected rail stations.

The parking count data revealed dissimilar before and after impacts across the affected stations: increases of 13%, 27% and 44% in observed vehicles at Brackenfell, Kraaifontein and Kuilsrivier stations respectively, compared to a mean increase of 14% across the control stations. The data suggests that with a weighted mean before and after increase of 29% at the affected stations combined, compared with a 14% increase at the control stations, the park-and-ride improvements could have resulted in a 15% increase in users. This increase at the control stations was surprisingly high and could unfortunately not be verified or triangulated by quantitative rail ridership data. Representatives of the rail operator confirmed that an increase in utilisation should be observable at the control stations but had no supporting quantitative evidence. This is due to the fact that rail ridership is only collected on an annual basis by the rail operator and accurate rail ridership data were not available for the period before and after upgrade. Furthermore utilisation rates were found to be highly variable, with clear evidence of 'churning' behaviour. This phenomenon can be said to be reciprocal changes in individual travel behaviour that are not reflected in aggregate travel behaviour change.

The intercept survey data revealed that 16% of the 43 new park-and-ride users interviewed were previously rail users who did not use any park-and-ride facility, and 67% were car users (including both car drivers and passengers). Given the absence of evidence of a uniform impact on commuting behaviour, a further (n=400) survey of non-users within the catchments of the affected stations was conducted to gauge how effectively the park-and-ride upgrades had been marketed. It was found that 56% of respondents were aware of the upgraded facilities, of whom 66% had heard of the facilities via the City of Cape Town's marketing strategy.

The dissertation suggests that the City of Cape Town's park-and-ride strategy might be improved to retain and attract users by providing improved security at the facilities. A common dissatisfaction expressed by respondents in the user survey was unreliable security provision over an insufficiently long duration. Further, the uneven impacts revealed in the study indicate that station selection and prioritisation criteria could be improved in future expansion and upgrade. In particular, it is clear that stations with a high- or over-utilisation of parking facilities are likely to yield better results than those with low-utilisation. A limitation in attracting significant growth in park-and-ride users from private transport is, however, car user perceptions of the quality of rail service.

An important methodological lesson emerging from the research is the potentially inaccurate conclusions on TDM (Travel demand management) impacts that could be drawn from a comparison of repeated before and after cross-section data. An important finding in the

research, emerging from the analysis of 12 month longitudinal data, was the significant variation and ‘churn’ in vehicle parking at the park-and-ride facilities. Arbitrary selection of before and after cross-section data collection dates could have led to highly misleading negative or positive results. Extended longitudinal before and after data collection in TDM assessment enables better understanding of unstable impacts.

SUMMARY

In **CHAPTER 1** it is stated that the dissertation's primary purpose is to determine the extent to which the upgrade of selected rail-based park-and-ride facilities in Cape Town's northern suburbs impacted commuter travel behaviour, and, at the same time to develop methods to measure and analyse these impacts. This purpose is envisaged to be fulfilled by research questions which include the following: have the utilisation rates of upgraded park-and-ride facilities increased?; what impacts did the upgraded park-and-ride facilities have on commuter travel behaviour and patterns?; why and when did users switch to park-and-ride use?; and how effectively were the park-and-ride facility upgrades marketed?

CHAPTER 2 expressed the need for a review of past and current literature. The purpose of this is firstly to provide a clear understanding of park-and-ride facilities, and secondly to provide benchmark information against which information collected in the dissertation can be compared.

Through this process it was envisaged to answer what impacts park-and-ride facilities have on commuter travel behaviour and how these impacts can be measured within a monitoring timeframe through a travel behaviour change experiment. Furthermore through these questions it is also envisaged to assess who park-and-ride users and non-users are. Non-users in this instance relate to commuters who do not use park-and-ride facilities, but who are able to use them due to the fact that they are car or other public transport commuters that travel in the same direction as the public transport mode where park-and-ride facilities are located. Lastly this process aims to answer why park-and-ride facilities are seen as a viable TDM strategy; and what good practise principles exist for the successful implementation of these facilities.

The literature review process showed that these facilities has been around from the 1970's and were seen as a cheaper alternative to road building, a way to encourage people out of their cars and onto buses and a generally more environmentally acceptable policy. Different types of park-and-ride facilities exist, each with their own purpose, form and shape. Suburban park-and-ride facilities seem to be the most well-known (and type studied in Cape Town).It can be said that park-and-ride facilities can be a viable travel demand management strategy that holds numerous benefits to users in terms of cost, convenience and their surrounding neighbourhoods, but can also have disadvantages which show the necessity for correct planning before implementation.

Furthermore the research indicated that information is needed to assess exactly why and when car commuters switch to public transportation and start using park-and-ride facilities. If this is known a park-and-ride strategy can be targeted to be most effective. The prior use of before and after surveys in assessing the impacts of park-and-ride facilities is very limited in South Africa which indicated that this research study is breaking new ground. The literature also suggest that the appropriate timeframe in assessing if an intervention did change travel behaviour is in the medium to long term which indicates that this study may not see the same change in travel behaviour that would be observed over the long term.

The literature review provided information on methods that have been used prior to this study in measuring the effect of park-and-ride facilities on commuter travel behaviour. These mainly included the use of vehicle counts and number plate recordings, parking counts, intercept surveys and mail-back surveys. This information provides a good basis for this research project to start from but must be adapted in order to make it relevant.

CHAPTER 3 examines the City of Cape Town process in selecting park-and-ride facilities for upgrade, while at the same time selecting park-and-ride facilities to form part of the dissertation case study that will be monitored over a period of 12 months. Through this the monitoring period will also be examined to see if any unforeseeable events took place which could have led to the data collected being subjected to bias.

In this chapter three affected rail stations, i.e. Brackenfell; Kraaifontein and Kuilsrivier and three control stations, i.e. Eikenfontein; Eersterivier and Melton Rose were chosen to form part of the study. These facilities was selected to provide the best results from the developed data collection methods which could be undertaken within the research projects budget and timeframe. As a result of the upgrades, the number of available park-and-ride bays increased from 355 to 455 at Brackenfell station and from 182 to 327 at Kuilsrivier station, while the number of bays at Kraaifontein; Eikenfontein; Eersterivier and Melton Rose stations remained the same at 210, 103, 100 and 55 respectively.

Reflecting on the characteristics of the affected and control stations all the park-and-ride facilities are within six kilometres of the nearest station. The use of all of the park-and-ride facilities is free of charge. All the facilities are located within 100m of the rail station. The public transport operating times are more frequent during peak hours than during off-peak hours while at the same time providing faster journey times than private transport. The fare for using the railway service is cheap in comparison to travelling into town by car.

The monitoring period examined comprised of three main periods, i.e. the period before construction during which parking counts and vehicle number plate recordings took place (6 June 2009 to 16 August 2009), the period during construction (1 February 2010 to 16 August 2010), and the period after construction during which a user and non-user intercept survey took place (17 August 2009 to 31 January 2010). These periods were also highlighted by events such as school and public holidays; fuel price increases and decreases; employee union strikes, FIFA World Cup and park-and-ride facility upgrade construction.

The purpose of **CHAPTER 4** was to discuss the research method used in order to assess the impacts of the park-and-ride facility upgrades in terms of data collection methods undertaken; objectives; sample size; and limitations.

With some time periods missing, parked vehicle number plate data were collected at the affected stations during the before period (6 June to 16 August 2009), construction period (17 August 2009 to 31 January 2010), and after period (1 February to 27 June 2010). The relatively shorter before period (2.5 months) was due to data collection only starting at this point. Data were collected between 08h00 and 17h00 on weekdays by security guards working for the South African Police Service's Commuter Safety Programme. The number plates of all vehicles parked in the park-and-ride facilities were recorded each day. A total of 6,501 vehicles were tracked at the six park-and-ride facilities. The reliability of the data collected by security guards was verified through a comparison with data collected by the researcher, and every month data were checked for inconsistencies. An analysis of the adequacy of the daily 08h00 to 17h00 data collection period was also undertaken, and it was found that this period was sufficiently long to capture the majority of vehicles using the park-and-ride facilities. It was observed that 94% of daily users arrive between 06h00 and 08h30, of whom 35% depart between 14h00 and 17h00 and 59% between 17h00 and 19h00. A spot parking count was undertaken by recruited fieldworkers on 7 December 2010 to establish whether any significant changes in utilisation had occurred over the period since 28 July when daily recordings ceased.

The (n=400) user intercept survey was undertaken at the park-and-ride facilities of the three affected stations between 9 and 20 August 2010. Ten trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride users on their return trip for the day,

between 15h00 and 18h30. The survey was designed to take no longer than 10 minutes to complete. The questionnaire (in English and Afrikaans) included questions on respondent socio-demographics, household characteristics, trip characteristics, patterns of behaviour before park-and-ride upgrade, and satisfaction ratings of the park-and-ride facility. New park-and-ride users were asked how they travelled before using the park-and-ride facility, and why they began using the facility. A (n=40) pilot survey was conducted on 2 June 2009 (after the school holiday and FIFA World Cup), in which no significant problems were encountered. All users of the park-and-ride facilities identified on the survey days were selected (i.e. a census), and interviewers were instructed to make alternative arrangements if the interview could not be undertaken at the point of first contact. Refusal rates were, however, in the region of 20%. Despite attempts to interview all users, and taking into consideration the rate of refusal, when compared to the parking count data at the affected stations during the after period it is estimated that only ±66% of all likely users in the survey period were interviewed. The sampling bias this may have introduced is unclear. The reason for missing these users is presumably because they alighted the train before or after the 15h00 and 18h30 intercept period, and were therefore not present. Questionnaire responses were coded and captured in a flat-line database.

Because the parking count data indicated that impacts at affected stations were uneven, a further (n=400) survey of non-users within their park-and-ride catchment was conducted to assess how effectively the park-and-ride upgrades had been marketed. Ten trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride non-users who lived in the catchment area and worked somewhere accessible by train. Interviews were conducted at a suitably located shopping centre (Fairbridge Mall) on two Saturdays (09h00 to 14h00, 7 and 14 August 2010). The survey was designed to take no longer than five minutes. The questionnaire (in English and Afrikaans) included questions on respondent socio-demographics, awareness of the park-and-ride facilities, media through which respondents became aware of the facilities, willingness to use the facilities, and reasons for not utilising, or not wishing to utilise, the facilities. A (n=40) pilot survey was conducted on Saturday 28 June 2010, in which no significant problems were encountered. Given that the target population of possible park-and-ride users is estimated to be in the region of 15,000 (assuming 1.5 commuters in 10,000 households), the margin of error of a randomly selected respondent sample of 400 is estimated to be 4.8% at a 95% confidence level. Questionnaire responses were coded and captured in a flat-line database.

Chapter 5 presents the findings of the three data collection methods discussed in the previous chapter resulting from 12 months of data collection. These are vehicle counts and number plate recordings, user intercept surveys and lastly non-user intercept surveys.

The vehicle number plate data revealed dissimilar before and after impacts across the affected stations whereby Brackenfell station experienced an increase of 13% in the after period compared to the before period, which, when compared to the mean 14% increase observed across the three control stations, suggests that the park-and-ride upgrade had little or no impact. Kraaifontein station experienced an increase of 27% in the after period, which, when compared to the control stations, suggests that an increase of around 13% may be attributed to the park-and-ride upgrade. Kuilsrivier station experienced an increase of 44% in the after period, which, when compared to the control stations, suggests that an increase of around 30% may be attributed to the park-and-ride upgrade and expansion. The data suggests that with a weighted mean before vs. after increase of 29% at the affected stations combined, compared with a 14% increase at the control stations, the park-and-ride improvements could have resulted in a 15% increase in users.

The daily utilisation of the park-and-ride facilities indicates a highly variable pattern, affected by a range of external factors such as school holidays, public holidays, public transport employee strikes, fuel price changes and even the weather.

The tracing of individual vehicles in the number plate data over time revealed a high rate of intra-personal variability in behaviour patterns. It was found that from week to week there are first-time users ('new users'), continuing users from the previous week ('repeating users'), and users who had stopped using the facility in the previous week(s) but had returned in the current week ('returning users'). This variation indicates that a phenomenon known as 'churn' – observed in the composition of traffic streams and public transport passenger flows is also present in park-and-ride utilisation. 'Churn' is observable in both the affected and control stations and cannot be regarded as a direct impact of the park-and-ride upgrades. No statistical difference was found in the magnitude of this phenomenon across the affected and control stations. The data also revealed no significant differences in the number of times individuals used the park-and-ride facilities per week in the before, construction and after periods.

Comparison of vehicle number plate recordings across the different rail stations indicated that in the before period some park-and-ride users utilised more than one facility on a regular basis. The other facility(ies) was typically within a six kilometres range. In the construction period this switching between facilities increased, as users sought close alternatives to avoid inconvenience. In the after period switching between facilities reduced again and stabilised. The switching between lots outside of the construction period highlights the methodological importance of assessing utilisation impacts at stations in geographical clusters rather than on an individual basis.

Analysis of the (n=400) intercept survey data indicated that park-and-ride users at the affected stations were mostly male (60%), aged 25-50 years (90%), white-collar workers (70%), and 'Coloured' (45%) and 'White' (38%). Ninety-seven percent of users owned a car or had access to a car, while the remaining three percent rode with another user who had the use of a vehicle. Interestingly, from the perspective of vehicle kilometres travelled reduction, 30% of respondents indicated that they drove to the park-and-ride facility alone, 48% indicated they drove with one other person, and 19% indicated they drove with two other people. Work trips accounted for 96% of trip purposes. The train service was identified by 84% of users to be the mode covering the longest stage of their trip.

Data analysis indicated that 89% of users were park-and-ride users before the upgrades were completed (i.e. before 1 February 2010), and thus only 11% of the users were new users. Of this 11% (or 43) new users, 67% were previously car users (including both car drivers and passengers),16% were train users who did not use a park-and-ride facility, nine percent were minibus-taxi users, and one percent were bus users, which indicates that the park-and-ride improvements may have had a small but discernable effect on mode choice. This proportion of new users is inconsistent with the parking count data, which would suggest that new users should be in the region of 22% of the after user group. A possible cause of this discrepancy might be more frequent weekly use by continuing users in the after period, and thus higher aggregate utilisation in this period without a proportionate increase in new users, but this was not readily apparent in the vehicle tracing analysis.

With regard to new and continuing user satisfaction with the upgraded park-and-ride facilities, 82% were dissatisfied with the fact that their vehicles were unprotected from the weather, 48% were dissatisfied with the number of security personnel, 43% were dissatisfied with the duration of the security service provided which did not cover early arrivals and late departures, and 24% were dissatisfied with the quality of service provided by security guards. Ninety-eight percent of the respondents indicated that they will keep using the park-and-ride facilities in the future.

The reasons cited by new users for why they started using the park-and-ride facilities related to reducing travel costs (55%), changing jobs (28%), and moving house (seven percent). With regard to changes in travel patterns, 47% of new users started leaving home later in the

morning to commute to work, 65% arrived home earlier from work, 72% experienced shorter travel times, and 86% indicated that their cost of travelling had decreased. With regard to how they became aware of the park-and-ride facility, 42% became aware through family and friends, 33% saw the new road signage outside the railway station, and 14% had seen newspaper articles.

This analysis further indicates that new users are mostly concerned for the safety of themselves and their property. The new users were mostly dissatisfied with the fact that their vehicles are unprotected from the weather. Secondly that there are not enough security personnel at the park-and-ride facility and that they are not friendly and helpful. Fourthly the security personnel are not there early in the morning when users start using the facilities and at night when the users return.

The continuous users were asked how they usually travelled to work before they started using the park-and-ride facilities in 2010 and 57% of them indicated that they commuted to their work by using the railway service. Of these users 30% indicated that they used their own vehicle to travel to their work.

The reasons why the continuous users, who did not always use the train to travel to work, started using the railway service were mainly one associated with cost. This implies that by using the park-and-ride facility, and through that the rail service, travel cost was cut substantially and was deemed by the user to be cheaper than commuting by car. Other reasons were that they starting using these facilities because of bad traffic congestion, their commute now is faster than with a car and that the rail service is more convenient than using the bus.

When the respondents were asked if there was any change in their personal life style that led to them using the park-and-ride facility, 71% indicated no, whereas the other 19% indicated that it was a direct result from them taking a new job and 10% because they needed to save money.

The respondents indicated that 89% of them mostly use the facility an average of five times a week which does not coincides with the vehicle registration number analysis. Ninety-eight percent of the respondents indicated that they will keep using the park-and-ride facilities in the future. The respondents also indicated that if there was a bus service between the park-and-ride facility at Brackenfell and Kraaifontein railway stations and the city centre (in both directions), that 81% of them would rather use the train than the bus.

It was found that continuous users, as with the new users, are also dissatisfied with the security aspect of the park-and-ride facilities and deem it to be most important. The continuous users also indicated that they are satisfied with the free usage of the facilities and that this is important to them.

In the affected rail stations 90% of users come from an area with a radius of four kilometres from the park-and-ride facility. The other 10% come from neighbouring suburbs mostly in a spherical form.

The non-user survey found that 90% of non-users own a car or have access to a company car. These non-users have access to an average of one vehicle that was indicated by 64% of car users, while 34%, two percent and one percent of non-users indicated that they have access to two, three and four vehicles respectively. The private car was indicated to be the main transport mode of non-users with a share of 74%. It is also apparent that the second most used transport mode is the train service by seven percent of non-users.

When the non-user respondents were asked if they are aware of the new upgraded park-and-ride facilities at Brackenfell or Kraaifontein railway station, 56% of them indicated that they are aware of these facilities. The users that indicated that they know of these facilities said that they became aware of it through the signage outside the station and mainly heard of it from family and friends. These respondents indicated that they do not use the facility firstly because the trains are overcrowded which is represented by 50% of the sample size and secondly that they perceive the railway service not to be safe and that their current transport provides more flexibility.

Of the respondents that indicated that they were not aware of the new upgraded park-and-ride facilities at Brackenfell and Kraaifontein railway station, the respondents indicated that only 47% of them would be interested in using the park-and-ride facilities. The main reason for not using the park-and-ride facilities was that the trains are overcrowded, unsafe and that they are afraid their car might get stolen. The non-users also indicated that if there was a bus service between the park-and-ride facility at Brackenfell and Kraaifontein railway stations and the city centre (in both directions), that 74% of them would rather use the train than the bus.

CHAPTER 6 discusses the research findings as set out in Chapter 5 and comments on the implications that this information holds for the transportation field.

It is argued that this research project shows the necessity for correct planning when implementing a travel demand management intervention or undertaking monitoring research on it. Although such an initiative it brought on to have certain impacts, the occurrence of unintended impacts is almost always unavoidable. Thus through taking enough time to do research beforehand, and looking for 'success stories' to imitate, the positive and negative impacts of such an initiative can be weighted up and informed decisions made.

The analysis of the data collected showed that there is no clear indication that the utilisation and average frequency of usage per week of the park-and-ride facilities increased as a result of the park-and-ride facility upgrades. The analysis did show that the phenomenon known as churn is present at park-and-ride facilities that might result in an increase in the usage of these facilities although slowly over time. The key is to put procedures in place to make the new users who enter the system each week loyal. What can be said is that because of the upgrades of the park-and-ride facilities that competition between the facilities decreased with users' now mainly using only one park-and-ride facility.

The analysis further showed that most park-and-ride users already used the railway service before starting using the park-and-ride facilities. This is a conversion from kiss-and-ride users to park-and-ride users.

CHAPTER 7 concludes that the main aims of the research were to establish whether the utilisation rates of park-and-ride facilities had changed following expansion and upgrade, how the upgraded facilities altered switching users' travel patterns, why and when new users switched to park-and-ride use, and how effectively the upgrades were marketed. With regard to utilisation rates, it was found that there was an increase in two of the three affected rail stations that might be attributed to facility expansion or upgrade. With regard to altered travel patterns, it was found that most new users reported positive impacts on their travel patterns with respect to travel time and cost. With regard to reasons for switching to park-and-ride use, and with the caveat that the sample of car use switchers in the survey is small, it was found that a desire to reduce travel costs was the main reason for switching from private to public transport commuting, and that switching was often associated with life style change in the form of starting a new job or moving house. With regard to marketing effectiveness, it was found that the City of Cape Town's park-and-ride marketing strategy was fairly effective, but insufficiently persuasive to convert large numbers of car commuters into rail commuters.

The City of Cape Town's park-and-ride strategy might be improved to retain and attract users by providing improved security at the facilities. A common dissatisfaction expressed by respondents in the user survey was unreliable security provision over an insufficiently long duration. The intermittent security provided at the facilities previously, was unrelated to the City's park-and-ride strategy. Further, the uneven impacts revealed in the study indicate that station selection and prioritisation criteria could be improved in future expansion and upgrade. In particular, it is clear that stations with a high- or over-utilisation of parking facilities are likely to yield better results than those with low-utilisation. A limitation in attracting significant growth in park-and-ride users from private transport is, however, car user perceptions of the quality of train service. Ideally park-and-ride strategies should be closely linked to innovative strategies to improve train service quality. This was not the case in the contemporaneous Metrorail Business Express service introduction and the park-and-ride strategy formulation (although the Huguenot-Cape Town Business Express service introduced in April 2010 does stop at Kraaifontein and Brackenfell stations).

An important methodological lesson emerging from the research is the potentially inaccurate conclusions on TDM impacts that could be drawn from a comparison of repeated before and after cross-section data. An important finding in the research, emerging from the analysis of 12 month longitudinal data, was the significant variation and 'churn' in vehicle parking at the park-and-ride facilities. Arbitrary selection of before and after cross-section data collection dates could have led to highly misleading negative or positive results. Extended longitudinal before and after data collection in TDM assessment enables better understanding of unstable impacts.

It is recommended that future research be done to study the long term effects on not only rail-based park-and-ride facilities, but also bus-based park-and-ride facilities which are the major transport interchange in cities around the world. This information, if available in South Africa, is not well documented and provides considerable scope for future research by academics. The reasons why car commuters reappraise their travel behaviour to shift to public transport is still vague, but is important information for the success of transport interchanges. The utilisation of park-and-ride facilities that serves as transport interchanges is mainly variable and incorrectly documented which needs to be reassessed. The use of kiss-and-ride facilities is also not well documented and methods virtually non-existent to assess the use thereof by commuters. The effect that the park-and-ride facilities have on traffic conditions in the neighbourhoods surrounding the facilities is still largely unknown and needs investigation. Future studies need to be carried out on the transport system as a whole that includes a commuter's journey to the park-and-ride facility and from that on the public transport system to where the commuter works. This is an integrated system that must work together in unison to see an effective shift of car commuters to public transport. Research on park-and-ride facilities is urgently needed whereby we can make better use of our existing infrastructure without investing a considerable amount of money to get car commuters away from the main stream traffic of morning and evening peak hours that leads to congestion, and on to the public transport system.

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CHAPTER 1

INTRODUCTION

1.1 Statement of purpose

This dissertation's primary purpose is to determine the extent to which the upgrade of selected rail-based park-and-ride facilities in Cape Town's northern suburbs impacted commuter travel behaviour, and, at the same time to develop methods to measure and analyse these impacts.

1.2 Background and motivation

The City of Cape Town is approaching a crossroad at which its transport system will be unable to accommodate future growth in travel demand, unless significant changes in travel behaviour occur. Against this backdrop the City of Cape Town formulated a travel demand management (TDM) strategy comprised of six main interventions, collectively aimed at reducing vehicular kilometres travelled and the number of vehicular trips during peak periods, namely: promoting higher private vehicle occupancies; implementing park-and-ride facilities; travel planning for large employers; marketing TDM and public transport; developing supporting policies and tax incentives; and exploring a congestion pricing scheme (CoCT 2006). The motivation for the research presented in this dissertation was that, in the formulation of this strategy, little attention was given to the systematic monitoring and assessment of the impacts of interventions. The measurement of TDM strategy impacts is in its infancy in South African cities, and little evidence has been found of prior before and after studies of the effect of TDM interventions on travel behaviour. A further motivation for the research was, therefore, the need to develop methods for undertaking such measurement.

Constraints on the research project, namely (1) the limited research time frame of two years and (2) the fixed funding available to complete the research, necessitated that an evaluation was undertaken to determine which TDM intervention would be the most appropriate to focus the research project around. This study is intended to fulfil this need with respect to one of the City's proposed TDM interventions: the rail-based park-and-ride project. This intervention was chosen because of the minimum level of risks involved. Firstly these risks include the implementation date, which without certainty would not lend enough time to undertake a travel behaviour experiment through collecting before and after data. Secondly the ease of collecting data from different sources, and lastly the need from the implementing agency to have an independent agency provide monitoring and assessment of the impact of the implemented TDM intervention led to the conclusion that this TDM intervention offers less risk than other interventions.

1.3 Aims and objectives

The aim of this study was, therefore, to determine the extent to which the upgrade of selected rail station park-and-ride facilities in Cape Town's northern suburbs changed commuter travel behaviour. Research questions included the following: have the utilisation rates of upgraded park-and-ride facilities increased?; what impacts did the upgraded park-and-ride facilities have on commuter travel behaviour and patterns?; why and when did users switch to park-and-ride use?; and how effectively were the park-and-ride facility upgrades marketed?

1.4 Structure of dissertation

The dissertation starts in Chapter 2 with a literature review which will firstly define park-and-ride facilities and assess the types of facilities that exist, and discuss the various positive and negative impacts encountered through the implementation of these facilities. This chapter also reviews a set of good practise guidelines that could lead to the successful implementation of park-and-ride facilities. The next section in this chapter discusses various theoretical frameworks used in previous park-and-ride facility and travel behaviour studies. Lastly this chapter will assess the different methods used for data collection in previous park-and-ride studies and will show their findings.

Chapter 3 will discuss the City of Cape Town's process towards upgrading park-and-ride facilities as well as the researcher's process in selecting facilities to form part of the dissertation's case study. Further this chapter characterises each park-and-ride facility that forms part of the dissertation's case study and shows a timeline of events that occurred during the research project's timeframe.

Chapter 4 provides a detailed description of the process undertaken for each of the three measurement methods used in this study, namely vehicle counts and number plate recordings, a user intercept survey and a non-user intercept survey, and the questions that were envisaged to be answered through them. The chapter also discusses the limitations of the three methods used and the data it will collect, with a description of how the researcher planned to overcome these problems.

Chapter 5 presents the research findings from analysis of the data collected through the methods explained in Chapter 4.The first section presents findings from parking counts and vehicle counts and number plate recordings (n=6,501) at six park-and-ride facilities (three affected stations and three control stations) over a period of 12 months. The second section presents research findings from an (n=400) intercept survey of Park-and-Ride users at the affected railway stations. The third section presents the findings of the non-user survey.

Chapter 6 will discuss the research findings as set out in Chapter 5 and will comment on the implications that this information holds for the research field as well as suggestions on how future impact assessment should be carried out in the City of Cape Town context.

The dissertation will conclude in Chapter 7 by reflecting on whether the objectives of the dissertation have been achieved, and if a contribution to knowledge has been made, as well as what questions within the research field remain unanswered. This chapter continues by suggesting what further research needs to be done in the field of park-and-ride facilities, as well as a discussion on how the City's park-and-ride strategy might be improved to increase its impact. The chapter concludes with a reflection on methodological lessons, particularly with respect to the value of longitudinal compared to repeated cross-sectional data collection in before and after studies.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The start of the dissertation firstly warrants a review of past and current literature. The purpose of this chapter is firstly to provide a clear understanding of park-and-ride facilities, and secondly to provide benchmark information against which information collected in the dissertation can be compared.

Through this process it is envisaged to answer what impacts park-and-ride facilities have on commuter travel behaviour and how these impacts can be measured within a monitoring timeframe through a travel behaviour change experiment. Furthermore through these questions it is also envisaged to assess who park-and-ride users and non-users typically are. Non-users in this instance relate to commuters who do not use park-and-ride facilities, but who are able to use due to the fact that they are car or other public transport commuters that travel in the same direction as the public transport mode where park-and-ride facilities are located. Lastly this process aims to answer why park-and-ride facilities are seen as a viable TDM strategy; and what good practise principles exist for the successful implementation of these facilities.

This chapter starts by explaining the process used to search for relevant literature to answer the set of questions mentioned above. It then continues by dividing the chapter into two parts. The first part will discuss the types of park-and-ride facilities in use today; positive and negative impacts of park-and-ride implementation and lastly good practise principles for the successful implementation of these facilities. The second part will discuss theoretical frameworks used to measure changes in commuter travel behaviour, i.e. methods used to measure these changes in previous park-and-ride studies and the findings of these studies which will provide benchmark information.

2.2 Literature review process

The documents that were searched for in the literature search included journal articles, books, and unpublished reports. Keywords based on the objectives of the dissertation research proposal were used to search for the relevant literature using library databases and internet browsers. Google was used as the main search engine to obtain electronic documents on the internet. Other documents were obtained from the City of Cape Town and the consulting firm implementing the new park-and-ride facilities. The libraries at the University of Cape Town were used to obtain books and journals used in this literature review.

From reviewing the reference lists in most of the documents on park-and-ride facilities and travel behaviour change it became clear there are some key scholars in this field, and their names were also used to obtain documents to review their research.

Efforts were made to ensure that the most recent literature on the topic was found. This is because according to literature review guidelines scholarship is cumulative, building on previous work. It is also a common complaint of journal editors that papers submitted often contain references which are ‘out of date’. The literature search continued as long as new

relevant documentation could be found. Once this ended the literature search came to an end and the analysis of the literature started.

2.3 Overview of park-and-ride facilities

Park-and-ride schemes were first put forward in the early 1970s as a way of dealing with increasing traffic congestion and to promote public transport ridership (Noel, 1989). They were seen as a cheaper alternative to road building, a way to encourage people out of their cars and onto buses and a generally more environmentally acceptable policy. The oldest park-and-ride facilities that have been continuously running are those in Oxford in the United Kingdom which were started in 1973 (CPRE, 1998).

Park–and-Ride (or incentive parking) facilities can be defined as public transportstations that allow commuters and other people wishing to travel into city centres to leave their personal vehicles in a car park and transfer to a bus, rail system (rapid transit, light rail or commuter rail), or carpool for the rest of their trip. The vehicle is stored in the car park during the day and retrieved when the commuter returns. Park-and-ride facilities are generally located in the suburbs of metropolitan areas or on the outer edges of large cities. It is not often possible to overnight at these facilities (http://en.wikipedia.org/wiki/Park_and_ride). Parking is generally free or significantly less expensive than in urban centres (http://www.vtpi.org). Short term parking areas, termed kiss-and-ride facilities are often provided to accommodate the dropping off and picking up of passengers as an alternative to parking a vehicle for a day (Pendulum Consulting. 2006). Park-and-ride facilities are meant for people who do not have ideal feeder public transport from their home (regarding schedule/travel time).

Park-and-ride facilities are usually introduced to reduce congestion along roads leading into the city centre (http://www.konsult.leeds.ac.uk) and to reduce congestion within the city centre. These facilities can reduce environmental externalities along roads leading to and within the city centre and possibly raise revenues for the public transport service. Lastly the introduction of these facilities can improve road safety and stimulate further growth in the business and tourist sectors without increasing transport externalities.

2.3.1 Types of park-and-ride facilities

According to Spillar (1997), who in his study set about classifying these facilities, park-and-ride facilities can be defined by their function or distance to the destination market.

2.3.1.1 Park-and-ride facilities defined by function

Informal park-and-ride facilities

The informal park-and-ride lot is often simply a public transport stop to which motorists regularly drive their cars and leave them parked on-street or in an adjacent property. Such impromptu park-and-ride operations may indicate the need for a higher order facility providing a safer environment for patrons and a more identifiable presence for transit. Informal park-and-ride lots can also be locations where carpool or vanpool formation takes place. These non-transit operations are often more difficult to discern within the urban fabric than are those connected with a transit stop. Informal park-and-ride lots can be close to the primary service destination or at great distance from it. The key to their formation is convenient access. They are often found at the intersection of major arterials or upstream of recurring congestion points or other natural geographic barriers to travel. Public investment in informal park-and-ride facilities is typically non-existent. Private investment is possible, but unlikely. The size of these facilities is unknown.

Opportunistic or joint use facilities

Opportunistic or joint use lots are characterised as sharing the facility with another activity such as a church, theatre, shopping mall, or special events centre. The park-and-ride activity can be either the secondary or primary use of the facility, depending upon the desired orientation and opportunity provided. Joint use lots can be constructed or procured at relatively low cost and developed fairly quickly if opportunities exist within the existing land use environment to encourage such facilities (e.g., available parking facilities which are unused during peak commuting hours). A primary concern when establishing a joint use lot is the arrangement of a long-term relationship between the implementing agency and the parking lot owner, usually requiring a two to five year commitment on both parts. Opportunistic lots can also describe smaller lots built near a local bus stop or major roadway intersection, taking advantage of surplus highway right-of-way or vacant lands. In most cases, opportunistic or joint use lots tend to be smaller than other lots, ranging between five and 30 spaces, but are occasionally quite large. If directly served by transit, they may be linked to local or express transit. Alternatively, they may be intended to serve only as a place for carpool and vanpool staging and formation. Public investment may be high or low, depending upon the enabling agreement and size of the lot. There is a great deal of potential for public-private joint venture in providing these facilities.

Park-and-Pool facilities

Park-and-pool lots are typically smaller lots, intended exclusively for the use of carpool and vanpool formation. This type of lot is often developed as an opportunistic or joint use facility, and may be a part of a development mitigation plan whereby a developer dedicates a (small) number of spaces within a larger development for park-and-pool purposes. Similarly, some transportation agencies such as the Texas Department of Transportation have made use of vacant right-of-way within highway interchanges or under overpasses to provide park-and-pool facilities. The size of these facilities is unknown.

Suburban park-and-ride facilities

Suburban park-and-ride lots, as the name suggests, are typically located at the outer edges of the urban landscape. The chief function of these lots is to collect potential transit patrons as close to their place of origin (their homes) as possible, and provide a transfer point to long-haul (often express) transit service. These facilities rely on the private automobile as the collection and distribution mode. They rely on trunk-line transit routes (bus or rail) to provide the long-haul aspect of the home-to-work trip. Suburban park-and-ride lots are typically funded by public investment, but can in some cases sustain private ownership. Opportunities for joint development and multi-use facilities are high, depending upon the specific location of the facility and transit services supported. The size of these facilities is unknown.

Transit centres (Intermodal transit centre)

A transit centre is often thought of only as a place where interchange between local and express transit services occurs. The fact that such centres often serve as park-and-ride facilities as well is often overlooked. As such, the transit centre can play a vital role in both the transit and park-and-ride networks. Transit centre park-and-ride lots have typically been built in higher demand locations than the typical suburban park-and-ride facility. They often offer the patron a much higher degree of travel services, route choices, and destination alternatives than is to be found at the latter. Although they typically require a greater investment on the part of the transit agency, they can portray a greater image of permanence on the part of the transit agency which, in turn, can generate opportunities for private investment in the centre. The size of these facilities is unknown

Satellite parking facilities

Satellite parking lots (also known as remote parking lots) are placed at the edge of an activity centre (i.e., sports complex, airport, or central business district) to provide relatively inexpensive alternatives to on-site parking within the activity centre itself. Thus, the satellite parking facility is characterised by its proximity to the destination end, rather than the origin end, of the travel market being served. The ability of these facilities to provide the same benefits as other types of park-and-ride facilities is questionable. Optimally placed park-and-ride facilities, located closer to the origin than the destination end of their intended travel market, provide several distinct benefits which the satellite parking facility cannot provide. First, park-and-ride facilities which are located near the origin end of the travel market provide the opportunity to improve air quality within the urban air shed. Air quality is typically affected by the number of vehicle trips made, the distance of vehicle trips made, the speed of travel, and the characteristics of the vehicle making the trip. Park-and- ride facilities placed near the origin of the trip greatly reduce the length of the auto portion of the trip.

Also, the emitting characteristics of the transit vehicle can be better controlled as compared to the private auto. Thus, minimising the auto access distance and maximising the transit travel distance provides a better chance of improving air quality. The satellite parking facility potentially maximises the auto access distance and minimises the transit vehicle travel distance. Park-and-ride facilities located close to residential trip generators can be designed to encourage walk access, reducing the total number of vehicle trips within the air shed, further improving air quality. The satellite parking facility does not provide this opportunity. It can be argued that satellite parking facilities reduce congestion within an activity centre and reduce demand for scarce parking resources. Some may say that such facilities even allow for the redevelopment of existing parking into higher and better uses. On the other hand, when using satellite parking facilities, congestion and parking demand is only shifted from the activity centre to the edges of the activity centre. Congestion on routes leading to the activity centre will still exist, as private autos attempt to access the satellite parking facilities on the centre's edge. In some cases, congestion may actually increase on approach roadways and within the activity centre because some drivers may traverse the activity centre to reach parking facilities moved to the opposite side of the centre.

Satellite facilities operate more as private parking lots than as intermodal facilities. If space within an activity centre is of sufficient demand to warrant the consideration of a remote parking facility, why not allow the free market to dictate the location and terms of that parking. In other words, by using public investment to build a free or low cost parking facility on the edge of an urban area, the implementing jurisdiction deprives the free market from providing the same facility. If provided by the free market, a price will likely be applied to the use of the remote facility while at the same time a higher price will be applied to the remaining parkway within the activity centre. Conversion of properties within the activity centre to their highest and best use will naturally occur once the value of the land exceeds the utility of the current use. The size of these facilities is unknown.

2.3.1.2 Park-and-ride facilities defined by distance to destination market

Suburban park-and-ride facilities

Suburban lots are the traditional facilities thought of when planning and designing park-and-ride facilities. According to the American Association of State Highway and Transportation Officials, suburban park-and-ride lots are defined as lots that are typically between six and 48kilometres from the CBD and that provide an intermodal or change-of-mode service. The predominant modal interchange is typically between the private automobile and transit mode, but may include modal changes between transit and bicycle, pedestrian, carpool, vanpool, or drop-and-ride modes, as well. Transit modes that may be

offered at the facility include: express and local bus transit, rail (heavy, light, commuter, and intercity), ferries, and paratransit. As indicated earlier, suburban park-and-ride lots tend to be publicly funded but can present significant opportunities for public-private joint ventures or outright privatisation. The size of these facilities is unknown.

Remote long distance facilities

Remote long-distance lots, similar to suburban facilities, provide an intermodal platform for change-of-mode activities. However, these lots typically lie farther from their primary service destination and may exist within a secondary or bedroom urban area to the primary centre being served. These lots are relatively new within the urban environment, and are a result of the rising costs of living in central metropolitan regions. They are typically seen where city pairs exist such as Dallas-Ft. Worth, Albuquerque-Santa Fe, Seattle-Tacoma, Denver-Boulder, and the communities of Northern New Jersey paired with New York City. Distances between the remote long-distance lot and the primary destination are typically 64 to 128 kilometres or more. Transit service between such distant locations and the central city has traditionally been the realm of the private intercity transit carrier (e.g., Trailways, Greyhound). However, as interurban travel demand increased between city pairs, and as suburban in-fill narrowed the distance gap between the city pairs, local and regional transit agencies have taken over the responsibility for these travel markets - providing basic services between the interrelated cities. From the user's perspective, avoidance of the drive commute becomes an important element in choosing to use such facilities due to the increase in personal costs of using a private automobile, resulting from increased congestion, slower average roadway speeds and overall deteriorating quality of the private auto commute. Remote long-distance park-and-ride facilities will require varying degrees of public investment, depending upon the demand for travel existing between the paired urban areas. If demand for travel is high, opportunities for privatisation may exist. The size of these facilities is unknown.

Local urban park-and-ride lots

Local urban lots are those lots that fill the gap between the suburban market and CBD within the metropolitan area. They are typically between two and six kilometres from the CBD and are often informal, shared use, or opportunistic lots. They are often served by only local or local-express transit routes. Interchanges between non-motorised modes of access and the transit system are likely to play a more important role at these facilities than at the more remote suburban lots. Local urban park-and-ride lots are often publicly funded, but also provide opportunities for private operation. Opportunities for small joint use facilities may exist and should be explored. The size of these facilities is unknown.

Peripheral park-and-ride facilities

Peripheral park-and-ride lots include those facilities built at the edge or periphery of a business district to provide additional parking just beyond the business district core. One type of peripheral facility - the satellite park-and-ride lot - has already been described. The chief purpose of the peripheral lot is to intercept travellers prior to downtown, storing their vehicles in locations where parking costs are relatively cheap and excess land is available. Parking patrons are then transported to downtown using local transit or a shuttle-type system. Urban areas typically resort to this type of facility when parking is limited in their downtown or when streets are extremely constrained or congested. A number of cities in Great Britain, including Bath, Cambridge, Oxford, and York, have successfully used peripheral and suburban park-and-ride lots to preserve the character of their town centres while providing additional parking within their municipalities. Peripheral lots must be analysed critically for their intended purpose. These lots are not well-suited to the task of reducing commute-oriented vehicle miles of travel and congestion on downtown-bound

streets (see description of satellite parking facilities). It can also be argued that such peripheral lots, depending on their proximity to the primary activity centre, do not provide for improved air quality or lessen the dependence on the private automobile. It is important for the implementing agency of such proposed facilities to consider the ability of the private sector to construct and operate such facilities on a for profit basis. Peripheral parking lots often will naturally appear without public investment, if parking is constrained within the central business district or primary activity centre. Thus, public investment in such lots should be carefully evaluated.

2.3.2 Positive impacts of park-and-ride implementation

The benefits of park-and-ride facilities are numerous according to the U.S. Environmental Protection Agency (2005). In terms of user costs, use of park-and-ride facilities can:

1. Reduce car insurance premiums for policies written by companies that base their rates on vehicle mileage and travel purpose.
2. Reduce fuel expenditures by reducing use of personal vehicles for the work trip.
3. Reduce vehicle depreciation by reducing vehicle miles of travel and exposure to potential vehicle damage.
4. Reduce vehicle maintenance costs by reducing the annual cost of mileage-related maintenance requirements.
5. Reduce travel related fees such as tolls and parking fees.

User convenience is also a benefit afforded by park-and-ride participation. These benefits include:

1. Reduced travel time when used in conjunction with high occupancy vehicles facilities or express bus or rail facilities, assuming good transportation connections, location of facilities close to the home end of the trip, and congestion which would be experienced by a competing auto trip.
2. Improved travel comfort resulting from a passenger not being responsible for driving the vehicle.

Societal benefits accrue to the community as a whole from park-and-ride programmes and are the basis for government involvement in their implementation. These societal benefits include:

1. Reduced energy consumption through diverting trips from single or low-occupancy vehicles to high occupancy vehicles or other energy efficient modes.
2. Reduced traffic congestion, depending upon the location of the lots and the amount of reduced travel resulting from the programme.
3. Reduced car air pollution in urban centres assuming a sufficient number of vehicles are removed from these areas, including reduced cold starts in CBDs. Reduced congestion allows for better vehicle operating speeds and more efficient vehicle operation.
4. Reduced parking demand at work sites and in the CBD where parking development costs are highest.
5. Increased public transport patronage by facilitating cost-effective line-haul public transport service to locations of higher trip density.
6. Improved access to jobs through increased ride-sharing opportunities, particularly if oriented to suburban employment areas not otherwise served by public transport.
7. Reduced *ad hoc* parking problems on private property or public ways without designated commuter parking.

Park-and-ride facilities might be successful if ran with a reliable, frequent, high quality public transport service (O'Cinneide, 1999). Also it will be deemed a success if the public transport service is quicker than a car. If parking in the city centre is difficult to find and if secure parking is available at the facility it might lead to a success. The park-and-ride facility must charge less for parking than the city centre otherwise there will be no sufficient demand for this facility and the site must be easily accessible.

On the demand side the impacts of park-and-ride facilities may encourage a change in travel behaviour. This can involve changing departure time, changing route, changing destination, changing mode, reducing the number of trips that the commuter is making currently, selling a car and also possibly moving house because of the effectiveness of the park-and-ride facility. (http://www.konsult.leeds.ac.uk)

2.3.3 Negative impacts of park-and-ride implementation

Despite these many benefits of park-and-ride programmes, some disadvantages can also be identified according to the U.S. Environmental Protection Agency (2005). These disadvantages can be minimised, though, if reasonable care is taken in the planning and design process. In terms of cost, park-and-ride facilities would normally not break even as a financial investment. In comparison to commercial CBD parking rates, either no user fee is charged or user fees at park-and-ride lots are kept low in order for park-and-ride to be competitive with alternative modes. As a result, capital, operating, and maintenance costs may not be recovered through parking fees. However, in terms of overall societal costs, by reducing the need to construct more expensive CBD facilities and by reducing highway congestion, these costs can be balanced.

A further possible disadvantage of park-and-ride programmes is their potential for transferring traffic and pollution problems from one location to another. Traffic and air pollution problems may increase in the areas where park-and-ride facilities are located. Examples of these problems include congestion on access routes and interchange ramps serving overused facilities, increased illegal traffic manoeuvres, increased *ad hoc* parking, and increased ambient air pollution levels in the vicinity of the lots. However, it should be noted that these impacts can be minimised through efficient planning and design of site access and lot location.

Park-and-ride facilities might not be successful if the congestion is not severe enough to influence a change of mode (O'Cinneide, 1999). If the park-and-ride facility is associated with multiple transport interchanges (car-train-bus-walk) for the commuters and if parking in the city centre parking is cheap or free it might lead to the failure of the facility. A major disadvantage to the success of the facility will be if the public transport facilities and their service are inadequate in terms of service or capacity. An inconvenient location of the park-and-ride facility will also have a negative effect on the success of the facility.

2.3.3.1 Unintended impacts

The possibility persists that through the implementation of park-and-ride facilities there may be unintended impacts on travel behaviour. The debate about the traffic impacts of park-and-ride schemes was intensified by the publication of evidence by Parkhurst and Stokes (Parkhurst and Stokes, 1994; Parkhurst, 1995) which demonstrated that the Oxford and York systems exhibited four effects which had not been intended by implementing the policy:

a) Lack of evidence for traffic reduction

It was not possible to demonstrate that park-and-ride resulted in a net reduction in urban congestion 'downstream' of the sites. The possible implication was that

suppressed demand had refilled the road space made available by car trips being intercepted at park-and-ride sites.

b) Withdrawing from modes other than car

Not all park-and-ride users drove cars to the city centres prior to the provision of the facilities, partly because a proportion of users had switched mode from public-transport services. The implication was that these people were using their cars more to reach the park-and-ride sites (although in some cases, where the park-and-ride service passed close to residential areas, some users were noted walking to park-and-ride services instead of accessing local public transport services).

c) Trip generation

Some extra journeys were made to the city centres via park-and-ride sites. As in the case of 'abstracted trips' (i.e. trips made to park-and-ride sites not using a car), the suspected mechanism was that introducing park-and-ride had lowered the generalised cost of travel.

It was argued that the three previous effects might add up to an overall increase in car travel, and that providing subsidies for motorists to park at the edge of the urban area might encourage car use in the surrounding hinterland and contribute to residential dispersion.

2.3.4 Past park-and-ride impact study results

A report by WS Atkins and the DETR published in September 1998 studied the travel effects of park-and-ride systems in Brighton, Cambridge Coventry, Norwich, Plymouth, Reading, Shrewsbury and York. Questionnaire surveys based upon the behaviour and views of park-and-ride users were carried out in each of the sites, with a second mail-back questionnaire used in six of the eight sites for non-users of the park-and-ride. This would help separate the views of these two groups.

The results found showed that:

- half of users use the park-and-ride facilities at least once a week;
- 85% of people drive to the lot, 11% walk, two percent are dropped off and one percent cycle;
- 92% of non-users know about the alternate possibility of park-and-ride;
- 21% of users drive less than two km to the site, indicating the potential for access by cycling or walking; and
- 16% of those questioned said that they would not have made the journey to the city centre had the park-and-ride been unavailable.

The study found that private car vehicle kilometres did experience a net decrease from the use of park-and-ride facilities and that the value of the decrease varied from site to site. The reduction in traffic was more significant in cities that also employed transport strategies that aim to remove long stay car parking in the centre and move it to the park-and-ride site, this effect was noted in York and Cambridge. This policy in York and Cambridge is helping to make it viable to increase the number of park-and-ride sites so decreasing potential diversion distance over time.

Other studies from round the world document an array of impacts from the introduction of park-and-ride facilities:

- While park-and-ride facilities reduce urban traffic, they had increased urban fringe vehicle traffic (up to three cars per kilometre) as motorists detour to reach facilities or make additional trips, and in some cases shift from a walk-transit to a drive-transit trip. (Parkhurst, 2000)
- Park-and-ride facilities reduced urban highway traffic congestion and worksite parking demand. (Park-and-Ride, Convenient Parking for Transit Users, 2008, Victoria Transport Policy Institute)
- Park-and-ride facilities may encourage urban sprawl by reducing the cost of long distance commutes. (Park-and-Ride, Convenient Parking for Transit Users, 2008, Victoria Transport Policy Institute)
- Non-drivers can benefit from increased demand for public transport and ridesharing, and from bike park-and-ride facilities. (Park-and-Ride, Convenient Parking for Transit Users, 2008, Victoria Transport Policy Institute)
- The main effect of the schemes is traffic redistribution, and their role within traffic restraint policies is unlikely to be directly one of traffic reduction. It was found that the traffic redistribution of intercepted cars were one and a half to six cars per kilometre. (Parkhurst, 2000)
- Park-and-ride could lead to an increase in vehicle-kilometres travelled. An increase of 13% was observed in this study. (Parkhurst 1995)
- Leaving a vehicle at home may result in greater vehicle use among other household members. (W.S. Atkins, 2008)
- The share of car drivers switching to park-and-ride will be relatively low (predicted between one to 19%) unless supported by measures designed to make parking on-site less attractive such as introducing parking charges (predicted between 14 to 37%) . (Hole, 2004)

2.3.5 Good practice principles for park-and-ride facilities

Faghri *et al* (2002), developed guidelines for application in choosing the most appropriate park-and-ride facility location. These guidelines were developed from a literature search and from professional feedback.

2.3.5.1 Position relative to the CBD or primary activity centre

Park-and-ride lots should be placed no closer than six to eight km preferably 16 km, from the CBD or activity centre (Fradd and Duff 1989). This provision reduces the potential for park-and-ride facilities to add to the traffic problem by being placed in the centre of congestion, and creates a manageable public transport ride for commuters.

2.3.5.2 Negative lot competition

Two or more park-and-ride facilities located within a six to eight km radius of one another are considered mutually negative competition (Fradd and Duff 1989). The literature suggests that if a particular facility is upgraded, that a facility within a certain radius of the upgraded facility may attract users that were intended for the upgraded facility as users become aware of this service and are starting to experiment with different facilities. Thus the capital investment of attracting an additional park-and-ride user becomes high. When considering the implementation of a new lot at a particular site, duplicate coverage should be avoided.

2.3.5.3 Travel characteristics to CBD or activity centre

If a large amount of inbound traffic passes a particular site, it may be a suitable location for a park-and-ride facility. General guidelines suggest that a corridor with a level of service of E or worse has a high potential for park-and-ride usage. Level of service E describes operations at capacity (http://en.wikipedia.org/wiki/levelofservice E). Flow becomes irregular

and speed varies rapidly because there are virtually not usable gaps to manoeuvre in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths; however speeds are still at or above 80km/h. Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream.

2.3.5.4 Maximisation of service area population

To reduce congestion and increase convenience, new park-and-ride facilities should be placed as close as possible to potential users. It has been shown that 50% of the demand for park-and-ride comes from population densities that are within an eight kilometre radius (Fradd and Duff 1989). In addition, an extra 35% of the users are located within a parabola that extends 16 km upstream from the lot with a long chord measuring 16 to 19 km (Fradd and Duff 1989). Another study found that approximately 90% of all park-and-ride users drive less than 16 km to the facility (Burns 1979).

According to Vincent (2007) studies undertaken in North America show similar behaviour, with Park-and- Ride users generally coming from an 'upstream' location lying broadly on an axis towards the CBD. A study in Seattle estimated catchment parabolas of around three to four kilometres towards the CBD and extending back around 16 km upstream (so approximately 19 km in total). Around 85% of site demand was located within this area. 50% of the demand was situated within a circle of a four kilometre radius centred on the site. A study on Texas found the same parabolic shape, but with different dimensions (one to two kilometres downstream and eight to 11 km upstream).

Other studies show little variation between cities: 53% of usage for Maryland came from within eight kilometres (81% within 16km), 60% for Sacramento within eight kilometres (82% within 16km) and 56% for Tri-Rail Florida within eight kilometres (86% within 16km).

2.3.5.5 Location relative to public transport service

Choice users are not willing to walk great distances to access a bus, a train, or light-rail, so potential sites must be relatively close to existing or future public transport lines. While it is not always possible to place a park-and-ride lot right next to a public transport stop, it is recommended to limit user walking distances to less than 400 m (Burns, 1979).

2.4 Theoretical frameworks for measuring travel behaviour change

This research project recognises the limitation of static data, and of utility maximisation-based theoretical explanation of travel choice, in analysing the dynamics of behaviour change. These prevailing methods of travel choice analysis have asked just how people choose between different alternatives (usually restricted to factors that influence mode and route choice), rather than how and when people choose between different alternatives. It is posited that travel choices are not made deliberately every day; that travel choices, if proven in past experiences to be satisfactory, tend to become habitual; and that travel habits are typically broken when some form of 'life shock' triggers a reappraisal of the habit and leads to an alternative deliberate habit-forming decision.

A growing body of literature suggests that individuals do not deliberately reappraise all aspects of their travel decisions on an almost trip-by-trip basis as is most evidently reflected in the utility maximisation theory-based mode choice step of the conventional four-step model. In essence, this body of literature argues that, if a travel choice has proven in past experiences to be of benefit or at least satisfactory to the traveller, that travel choice becomes habitual.

The literature labels this conversion from deliberate to habitual decision-making as a transition from 'preference-based' to 'script-based' choices (Garling and Axhausen, 2003). Travel habits

are argued to be broken typically when some form of 'life-shock' (e.g. moving house, changing jobs, children starting school, etc.) or 'critical incident' (e.g. car accident, mugging, sharp increase in fuel cost, etc.) occurs which forces a reappraisal of the habit and leads to another deliberate, potentially habit-forming, decision.

It is posited in the 'principle of least effort' (see Chisholm 2000) and in goal setting and self-regulation' theory (see Garling *et al* 2000, Loukopoulos *et al* 2004) that, when considering change, individuals will experiment with behaviour changes that require the least planning effort and cost to implement (e.g. changing departure time, route, or destination in the case of discretionary trips), and that if these prove unsatisfactory, only then do they implement behaviour changes that require greater planning effort and cost (e.g. changing travel mode).

2.4.1 Before and after surveys for measuring travel behaviour change

Although the surveys used in the park-and-ride study are retrospective, it is important to review previous studies where before and after surveys were used for measuring travel behaviour changes. Before and after surveys are a common method of measuring the effect of specific policies and projects designed to cause changes in travel behaviour. The use of before and after surveys for this study means that we will be able to assess the status quo of users and then what changes were made by users if any after the implementation of the intervention. Richardson *et al* (2003) consider some issues involved in the design of before and after surveys required for the evaluation of a Travel SMART programme designed to change travel behaviour:

2.4.1.1 Type of data collected

As a priority the evaluation of Richardson *et al* (2003) required specific quantified before and after measures of vehicle kilometres of travel (VKT), air quality, GHG (greenhouse gas) emissions and changes in modal split for trips and distances.

2.4.1.2 Type of survey

There are two types of survey that might be used in the study: a repeated cross- sectional survey and a longitudinal panel survey. In identifying changes in behaviour, a longitudinal panel survey is clearly the preferred option (statistically) since the between-sample variance is eliminated. This enables statistically significant changes to be identified with a smaller sample size in the before and after surveys. However, a major problem with a longitudinal panel survey is the reduced response rate, especially in the after survey.

2.4.1.3 Respondents

For Richardson *et al* (2003) the major decisions to be made with respect who data should be collected from are, firstly, whether data is to be collected about people's travel patterns or about vehicle's travel patterns and, secondly, whether data is to be collected from all people (or vehicles) in a household or from only one person (or vehicle) in a household.

Collection of data about vehicle travel patterns is appropriate when the prime emphasis is on the measurement of VKT and vehicular use. Data on people's travel pattern is more appropriate when the emphasis is on the reasons for travelling and on the use of non-private-vehicle modes of transport.

Restriction of the survey to a single person or vehicle means that re-allocation of activities and travel between members of the household cannot be detected. Since one of the major objectives of Travel SMART is to encourage household members to devise more effective ways of undertaking the activities associated with their particular lifestyles, it might be

expected that intra-household re-allocation of activities might be an option that needs to be monitored. Therefore, the travel patterns of the entire household need to be measured. In the context of a vehicle monitoring survey, this means monitoring the usage of all vehicles in the household. For practical reasons, this means monitoring up to three vehicles per household (which will cover 98% of all households).

2.4.1.4 Data collection period

The major decision here for Richardson *et al* (2003)was whether the survey should take place over one day or over a multi-day period. Statistically, the survey could be restricted to one day. However, because of the larger relative variability in daily travel, compared to say weekly travel, a much larger sample size of households would be needed in order to detect a specified difference in travel behaviour before and after the Travel SMART programme implementation. For example, data from the MobiDrive surveys in Germany showed that the coefficient of variation for daily household vehicle kilometres (within the same household) was two and a half times the coefficient of variation for weekly household vehicle kilometres (where the coefficient of variation is the standard deviation divided by the mean). Since sample size is proportional to the square of the coefficient of variation, this would require about six times as many households doing seven day travel surveys as would be required for households doing seven day travel surveys.

There is also a particular reason in Travel SMART why a multiday survey would be more appropriate. Just as there may be re-allocation of activities and travel between household members, there may also be re-allocation of activities and travel across the days of the week in order to achieve a more efficient travel pattern (e.g. saving up several activities in one area and then doing them all on one day on a single trip). For this reason, there is an advantage to undertaking a multiday (preferably seven day) survey that will capture these re-allocations across days of a complete week.

2.4.1.5 Period between before and after survey

While the concept of before and after surveys are relatively straightforward, it is not very clear what is meant by ‘before’ and what is meant by ‘after’. Clearly, the before survey should be performed before the programme is implemented and, where the programme involves direct contact with participants, the before survey should be sufficiently far in advance so as not to influence the performance of the programme. For example, some Travel SMART initiatives involve the participants in the completion of travel diaries, on the basis of which they are advised of potential behavioural changes. If they are previously required to also complete a before travel diary, then this could affect their willingness to participate in the Travel SMART programme itself.

The timing of the after survey is even more problematic. Short-term changes can be captured by conducting the after survey shortly after implementation of the Travel SMART programme. On the other hand, there is a keen interest in seeing whether any behavioural changes are sustainable in the long run. For this purpose, the after survey should be performed sometime after the implementation of the programme. While there are advantages in increasing the length of time between the before and the after surveys (from the perspective or dispersing respondent burden and measuring long-term success of the programme), there is a major problem with this course of action. By increasing the time between the two surveys, one is increasing the probability that other changes will also be occurring, in addition to the Travel SMART programme. Such changes could include changes in public transport, fares, changes in petrol prices and changes in the infrastructure or transport services provided. One is then faced with the problem of disentangling the effects of the Travel SMART programme from the effects of all the other external changes occurring in the background.

According to Behrens *et al* (2007), if the monitoring timeframes are too short, assessment of failure and subsequent abandonment will be premature. Here they argue that firstly the pace of change following the initiation of TDM strategies can be expected to be slow. They suggest that changes in commute travel behaviour occur on average in the order of once every eight to 17 years, depending on which trip decision element is considered. In the absence of a TDM intervention that universally and abruptly changes the generalized cost of single occupancy car travel by a considerable margin over the longer term, behavioural changes to TDM strategies are likely to occur slowly, at a pace determined, by churning changes that are occurring anyway.

Secondly depending on what trip making behaviour is being targeted, some TDM measures are likely to have shorter response lags than others, on the grounds that some elements of trip decisions are changing anyway more rapidly than others. TDM measures aimed at changing trip time behaviour are likely to have shorter term response rates, followed by measures aimed at route choice, then vehicle occupancy, and in the longer term, mode switching, and origin/destination choice.

Thirdly looking at the timeframes of TDM strategy monitoring and assessment, and subsequent updating and revision, if these timeframes are too short assessments of failure and subsequent abandonment will be premature. It is therefore suggested by the literature that assessment of TDM strategies needs to occur over the medium to long term because the fuller impacts of TDM strategies are experienced in five to 10 year timeframes and in some instances possibly longer.

2.4.1.6 Number of surveys

To minimise the problems in having a long period of time between the before and after surveys, Richardson *et al* (2003) recommend multiple number of after surveys in order to pick up the short, medium and long term effects of the programme. The problem with this approach is that the increased number of surveys will increase the burden on the respondents, and could lead to increased bias due to increased rates of attrition.

Multiple after surveys are particularly a problem when each survey involves interaction with the respondent and the expenditure of effort by the respondent. However, where the survey can be done with minimal effort, the increased burden due to multiple surveys may be minimal. For example, some types of odometer survey require minimal effort on the part of the respondent, enabling long-term monitoring of VKT. Similarly, the use of GPS monitoring of vehicles enables detailed long-term monitoring of vehicle use with virtually no extra effort on the part of the respondent.

2.4.1.7 Magnitude of difference detected

Because of the nature of before and after surveys, it is necessary to specify the size of the difference to be detected between the two surveys. Detection of a small difference will require a larger sample size compared to detection of a large difference. One might therefore be tempted to opt for detection of a large difference, if this can be done with a smaller sample size. However, if such a large difference does not in fact exist, then any smaller differences will not be detected (statistically).

On the other hand, the collection of a large sample in order to detect a small difference may not be worthwhile if the effect of the difference detected is immaterial. Therefore, one needs to trade-off these two effects, and specifies a difference which could reasonably be expected to occur, and, if it was detected, then the effect of this difference would be material. The

client needs to specify a difference in the parameter(s) with which they would be satisfied if it was detected.

2.4.2 Previous park-and-ride research methods

From reviewing the literature it is clear that there have been different methods implemented to collect data on usage/impacts of park-and-ride facilities and information on the users of the facilities. A study in Edmonton in the USA used the recording of car registration numbers of cars parked in the park-and-ride lots to determine the origin of the parking lot users (Monitoring services, (2008), City of Edmonton).

Spyer (undated) used a method of distributing questionnaires at park-and-ride entrances and allowing the respondent to complete the questionnaire in his/her own time and returning it when the respondent returned at the end of the day. The aim of these particular questions was to determine the factors affecting the driver's choice of using park-and-ride or the city centre car park. Foo Tuan Seik (1997) retrieved the questionnaires the following day. It became clear from the literature that intercept surveys were used as the main method for data collection at the park-and-ride facilities itself.

Parking counts for obtaining an indication of park-and-ride usage is a regular method used in almost all park-and-ride studies to determine the status quo. No particular method, time period etc. are stated in the literature for collecting this data.

2.4.3 Findings of previous park-and-ride studies

Spyer (undated) undertook a survey to understand the socio-characteristics of a sample of park-and-ride users in Swansea, South Wales, and to identify any differences between park-and-ride users and non-users. This was largely based on the standard criteria of age, gender and occupation. The number of cars owned by the driver's household was another question in this category.

2.4.3.1 Driver's age

When analysing the drivers age in comparison to the drivers parking choice, there was a statistically significant relationship. Spyer found that people between the age of 42 and 51 and people younger than 21 were the majority users. In a study done in Singapore over half of the respondents (54%) were in the middle age group of 30-39, 16% were of age 29 and below, 23% were in the 40-49 age group category, and seven percent were in the age group 50 and above. WS Atkins, however, found in their study in 1998 that non-users and users were of a similar age.

2.4.3.2 Driver's gender

In Spyer's study there was no significant relationship between gender and park-and-ride usage. It was decided to study this finding in more depth by linking gender to the age of the survey base. It was found that there is a relationship between gender and the age of the driver, it is interesting that males predominate in the age groups that are most likely to use the park-and-ride scheme. It was concluded that few women over the age of 45 used this scheme, the prognosis they offer is security at the site.

This was also observed in Korea by Young Jong Kwon (2001) as the results of a questionnaire survey, 78%percent were men and 21.9% were women. In contrast to this, O'Cinneide (1999) concluded in his study that women tend to us park-and-ride services more significantly then men. WS Atkins (1998) found that over two thirds of users were female, with non-users of park-and-ride facilities being an even split.

2.4.3.3 Driver's occupation

The driver's occupation will vary depending on the chosen location and the time the survey is undertaken. Swansea which is an administrative centre for the surrounding region has in recent years moved away from a reliance on traditional heavy industry towards a service sector economy. There was little of significance in the findings accept that white collar workers are less likely to use the park-and-ride scheme than any other occupation. Confirmation was also found that the elderly, in this case retired people are more likely to use the park-and-ride scheme.

Young Jong Kwon (2001) concluded in his study that 57% of park-and-ride users were professionals. While, own-businessman and students were 21% and six percent, respectively. In Singapore they found that 75% of the respondents were professionals, managers or administrators. The nature of their jobs suggests that they hold desk-bound jobs or jobs where company transport can be used during working hours. Respondents with occupations where personal car travel is necessary and frequent such as those in the sales, services and business fields, were a minority. Only nine percent were working in the sales and services occupations and only four percent were businessmen. The rest were respondents holding technical and other types of jobs (10%).

2.4.3.4 Number of cars owned in the driver's household

Spyer (undated) concluded that no significant relationship was found when examining the whole survey base. However a close examination of the three or more car group, suggests that they are more likely to use the city centre car parks. Income level would be the obvious conclusion to draw from this finding.

In a Chicago Transit Authority survey, Foote (2000) found a typical profile of the park-and-ride users. Most of the users were white (70%), female (62%), with a mean age of 43 years, average household size of 3 with an income of USD 51,400. Most of the respondents (87%) use park-and-ride in their commute to work.

2.4.3.5 Behavioural characteristics of park-and-ride facility users

The most detailed literature that could be found on behavioural characteristics of park-and-ride facilities was a study undertaken in Korea by Young Jong Kwon *et al* (2001) who focused on the influencing elements for park-and-ride usage. They concluded that according to:

2.4.3.5.1 Trip purposes

For their trip purposes, trips for commuting to workplace and attending school shared 43%. While, business and shopping trips shared 27% and 12%, each in the particular study. Trips for personal meeting and entertainment shared seven percent. The proportional share of trip purposes showed difference by the facility types. For the proportional share of trips for commuting to workplace and attending school, the users of park-and-ride facilities located between the CBD and suburban areas showed the highest of 60%.

2.4.3.5.2 Travel time

For travel time from origin to destination, the users of park-and-ride facilities took longer than car commuters. The difference of travel time between the users of park-and-ride facilities and car commuters differs by the facility types. For the difference of travel time between the users of park-and-ride facilities and car commuters, the users of park-and-ride facilities

located between the CBD and suburban areas showed to be eight minutes slower than car commuters.

2.4.3.5.3 Travel cost

For travel costs, the average travel cost of the users of park-and-ride facilities showed about ±R400 per month lower than that of car commuters. For the travel cost savings, the users of suburban type park-and-ride facility showed higher than those of urban type facility because the latter was caught up in congestion.

2.4.3.5.4 Frequency of park-and ride facility use

For the frequency of the facility use, about 38% of the total users use the facility five to seven times a week. Sixty-five percent of respondents indicated that this frequency of five to seven times a week was for trips to and from work.

2.4.3.5.5 Purpose of using the park-and-ride facilities

For the purpose of using the park-and-ride facilities, trips to work and for other things around the facility shared 60%. Those who are using the facility for transfer to rail and bus shared only 32%. This means that the park-and-ride facilities do not operate as transfer facilities. The proportional share of the purpose of using the facilities showed difference by the facility types. For the proportional share of the purpose of using the facilities for transfer to rail, park-and-ride facilities located between the CBD and suburban areas users showed the highest of 48%.

2.4.3.5.6 Reason for using the park-and-ride facilities

Difficulty of parking in the CBD was indicated by 35% of respondents to be the major reason for them starting to use park-and-ride facilities. As the second reason of using the park-and-ride facilities, highway congestion to their destination were indicated by 24% of respondents. Meanwhile, travel time and cost savings were minor reasons for using the park-and-ride facilities. It was because the railway lines are in and out and it takes a long time to get to destinations located in CBD areas. In contrast to this WS Atkins (1998) concluded in his study that cost, convenience, reliability, frequency, difficulty in parking and faster journey time were the reasons given by users in this order for why they switched to park-and-ride. Reasons for non-users to avoid park-and-ride were perceived speed, ease of driving directly into the centre, proposed length of stay and limited mobility. Of these factors, the non-users and users pointed to cost and journey time being the most likely to influence their decision on whether to switch to park-and-ride or not.

2.5 Summary and conclusion

The literature review process has shown that considerable research on park-and-ride facilities exists elsewhere in the world. These facilities has been around from the 1970's and were seen as a cheaper alternative to road building, a way to encourage people out of their cars and onto buses and a generally more environmentally acceptable policy.

Different types of park-and-ride facilities exist, each with their own purpose, form and shape. Suburban park-and-ride facilities seem to be the most well-known, and indeed are the focus of this dissertation's case research in the City of Cape Town's northern suburbs.

It can be said that park-and-ride facilities can be a viable travel demand management strategy that hold numerous benefits to users in terms of cost, convenience and their

surrounding neighbourhoods. However these facilities may hold some disadvantages which show the necessity for correct planning before implementing such an intervention.

Research else where has shown that if attention is given to the park-and-ride facilities position relative to the CBD, negative lot competition, travel characteristics to CBD, maximisation of service area population , location relative to the public transport service and frequency of the public transport service, an appropriate site for park-and-ride implementation or upgrade can be determined with good results.

Furthermore the literature review indicated that information is needed to assess exactly why and when car commuters switch to public transportation and start using park-and-ride facilities. If this is known a park-and-ride strategy can be targeted to be most effective. Together with this, the use of before and after surveys in assessing the impacts of park-and-ride facilities is virtually non-existent which indicated that this research study is breaking new ground in terms of finding out how the park-and-ride changed travel behaviour. The literature review also suggests that the appropriate timeframe in assessing if an intervention changed travel behaviour is in the medium to long term, which indicates that this study may not see the level of change in travel behaviour that could be observed if monitored for longer.

The literature review provided information on methods that have been used prior to this study in measuring the effect of park-and-ride facilities on commuter travel behaviour. These mainly included the use of vehicle counts and number plate recordings, parking counts, intercept surveys and post back surveys. This information provides a good basis for this research project to start from but must be adapted in order to make it relevant for this study.

In terms of the characteristics of park-and-ride users, keeping in mind that this is highly content specific and may not be the same as in South Africa, studies have found that these users are mostly between the ages of 21 and 50 with men mainly being more willing to use the park-and-ride facilities than women. These users are more than likely to be professionals and use these facilities for work and school purposes. Park-and-ride facilities have shown to not always provide a shorter journey time than private transport but will definitely have a reduction in travel cost as a result. Park-and-ride users from previous studies indicated that their reason for using these facilities is mainly because of the difficulty of finding parking in the CBD as well as convenience, reliability, cost, frequency and faster journey times.

CHAPTER 3

CASE STUDY

3.1 Introduction

In the previous chapters a travel demand management intervention, i.e. park-and-ride facility upgrades, was identified which would be implemented by the City of Cape Town during 2009 and 2010. This intervention necessitated the need for an independent agency to provide monitoring of the implementation after the facility upgrades. This dissertation will fulfil this need by determining the extent to which the upgrade of selected rail-based park-and-ride facilities in Cape Town's northern suburbs impacted commuter travel behaviour, and, at the same time to develop methods to measure and analyse these impacts. Chapter 2 presented the literature review undertaken to provide a clear understanding of park-and-ride facilities, and to provide benchmark information against which primary data collected in the dissertation can be compared.

The purpose of this chapter is to examine the City of Cape Town's process in selecting park-and-ride facilities for upgrade, while at the same time justifying the selection of park-and-ride facilities as the focus of the dissertation case study that will be monitored over a period of 12 months. The monitoring period will also be examined to see if any unforeseeable events took place which could have led to the data collected being subjected to bias.

This chapter starts by explaining the evaluation process that the City of Cape Town undertook to select park-and-ride facilities within the Cape Town metropolitan for upgrade. It continues by discussing why certain park-and-ride facilities were selected to form part of the dissertation case study and gives a description of these facilities in terms of station demographics; parking, service and catchment area characteristics. Lastly this chapter explains the monitoring period of the dissertation case study by defining the periods before, during and after upgrade and events that took place in these periods that may or may not have had an impact on park-and-ride usage or subjected bias to the data collected in the monitoring period.

3.2 City of Cape Town's evaluation process for park-and-ride facilities upgrade selection

In 2006 a business plan was developed for the short term implementation of pilot park-and-ride projects in Cape Town (ITS Engineers 2006). The business plan included an evaluation of the most suitable rail stations for park-and-ride facility provision or upgrade, an implementation programme, and a cost structure. In 2008 the City allocated a budget of R47 million for the extension and upgrade of rail station park-and-ride facilities, with a focus on improvements for the 2010 FIFA World Cup. Later in 2008 the implementation plan was revised, and a more detailed identification and prioritisation of candidate rail station park-and-ride facility upgrades was undertaken (Illiso Consulting 2008).

The criteria used to identify candidate stations included, *inter alia*:

- distance from city centre (All stations within ±10 km from the city centre were excluded from the list.);
- rail capacity (Preference was given to rail corridors with spare passenger capacity.);

- optimised coverage (Stations with large overlapping [two and a half km radii] catchments were discarded. In choosing between adjacent stations, preference was given to the station closer to the city centre to avoid users travelling away from their destination in order to make the transfer to rail.); and
- densification corridors (Stations within corridors targeted for densification, in the form of the Southern Suburbs rail line adjacent to Main Road and the Bellville rail line adjacent to Voortrekker Road, were prioritised.)

These criteria yielded 30 candidates rail stations, which were then prioritised, *inter alia*, on the basis of the following further criteria:

- potential to retain existing users;
- potential to facilitate discretionary trip-making from the station as part of a home-based tour;
- potential to attract new users and replace vehicle kilometres travelled with rail passenger kilometres (calculated as the potential demand for parking at each station, multiplied by the distance travelled between the station and the destination zones); and
- potential to make station precincts more attractive to pedestrians and cyclists, and improve urban design aesthetics.

The prioritisation exercise identified 14 stations for park-and-ride upgrade, of which, to date, only Brackenfell, Kraaifontein, Kuilsrivier, Monta Vista, Ottery and Retreat rail stations have received upgrades.

3.3 Selection of park-and-ride facility case studies

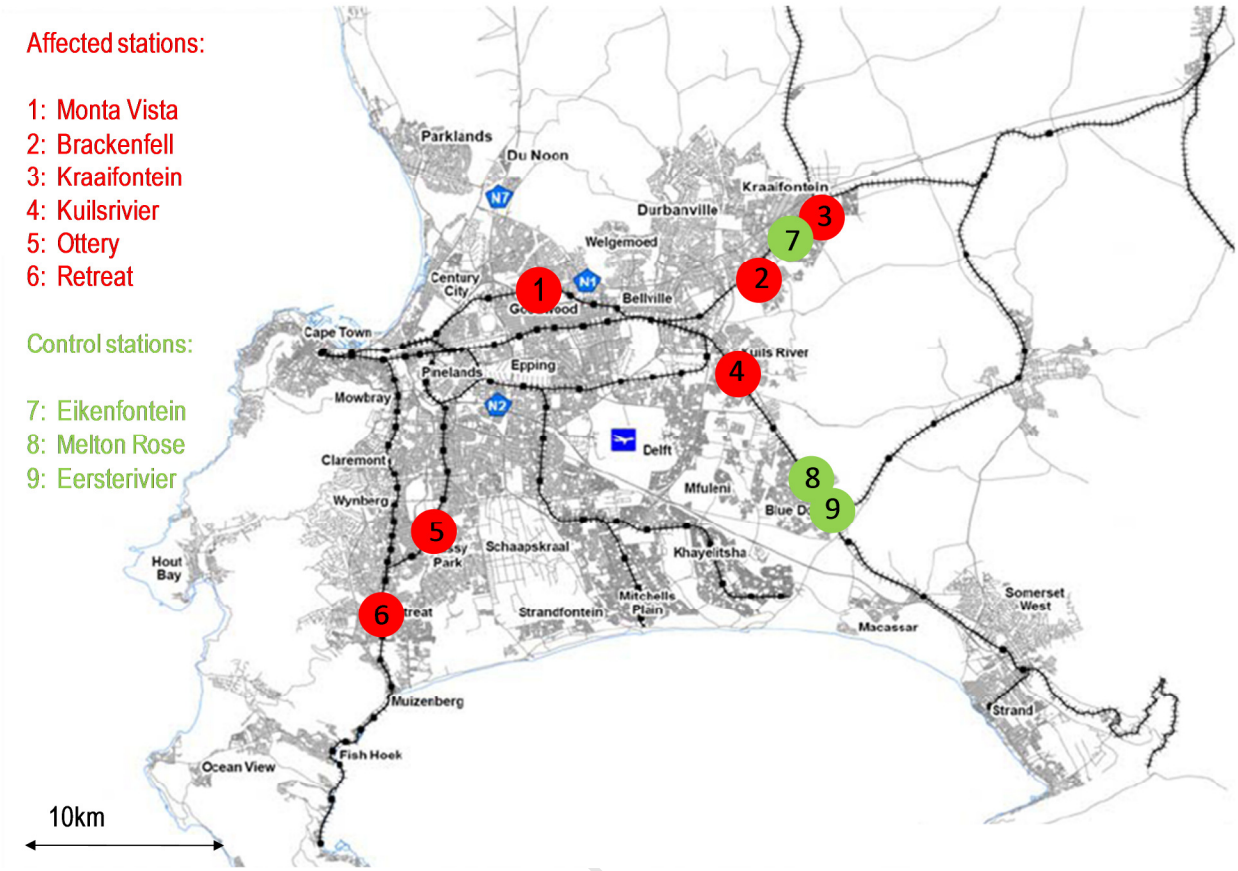
As a requirement the park-and-ride facilities, which would be selected to form part of the dissertation's case study, had to lend enough time in order for before and after data to be collected to assess if a change in travel behaviour occurred. It was only known at the time that Brackenfell, Kraaifontein, Kuilsrivier and Monte Vista rail-station's park-and-ride facilities would be upgraded within the research project's timeframe. Therefore it was initially decided to only include Brackenfell and Kraaifontein railway station's park-and-ride facilities as part of the case study. During the research method design the inclusion of control stations was warranted to assist in assessing whether any utilisation changes observed across the before and after periods were the result of external factors. The researcher therefore decided to also include Eikenfontein, Eersterivier and Melton Rose railway station's park-and-ride facilities as control stations. It was later learned that information was already being recorded on the utilisation of these facilities by the South African Police Service's (SAPS) Commuter Safety Programme and that another station could be included in the park-and-ride facility case study i.e. Kuilsrivier station who would also receive park-and-ride upgrades.

The reason for excluding Monte Vista from the case study was because data collected at the other facilities undertaken by the SAPS "Commuter Safety Programme" (see later discussion in section 4.2.1) was not undertaken at this facility. In conclusion, for this research project six park-and-ride facilities were chosen at six railway stations in the City of Cape Town's northern suburbs to be evaluated. Firstly three affected park-and-ride facilities at Brackenfell, Kraaifontein and Kuilsrivier railway station who received park-and-ride upgrades and secondly three control park-and-ride facilities at Eikenfontein, Eersterivier and Melton Rose railway stations who did not receive any park-and-ride upgrades.

3.4 Characteristics of park-and-ride facility case studies

The location of each of these railway stations with adjacent park-and-ride facilities are indicated in Figure 1.

Figure 1: Locality of rail stations



The characteristics of each railway station and their park-and-ride facility are listed in table 1 below. It divides park-and-ride facility characteristics into four categories. These are firstly the stations characteristics which indicate where the station is located and its distance relative to the CBD, nearest station and nearest freeway. Secondly the parking characteristics of the park-and-ride facility i.e. the amount of parking bays before, during and after the park-and-ride upgrade process, the distance of the park-and-ride facilities relative to the railway station and the charge at these facilities. Thirdly the service characteristics of these facilities rail service i.e. the average public transport frequency of the service during peak and off-peak time; the amount of boarding and aligting passengers per weekday and the tariff of the transport service. Lastly it looks at the characteristics of the park-and-ride catchment areas in terms of percentage employed who uses a car, the percentage employed who uses the public transport system, population size and the average income level of households in the catchment area.

Firstly the three affected rail stations: Brackenfell, Kraaifontein and Kuilsrivier (see also figures 2 - 4) had as a result of the upgrades, the number of available park-and-ride bays increased from 355 to 455 at Brackenfell station and from 182 to 327 at Kuilsrivier station, while the number of bays at Kraaifontein station remained the same (210). The additional three control stations: Eikenfontein; Eersterivier; and Melton Rose have 103, 100 and 55 parking bays respectively.

Secondly it should be noted that all the facilities are within 6km of the nearest station. The use of all of the park-and-ride facilities is free of charge against the City of Cape Town's parking bays who charges users for its usage. All the facilities are located within 100m from the rail station. The public transport operating times are more frequent during peak hours than during off-peak hours while at the same time providing faster journey times than private

transport. The fare for using the railway service is cheap in comparison to travelling into town by car. Brackenfell has the highest percentage employed residents using a car to commute to work, and the lowest percentage employed residents using public transport to commute to work. Melton Rose and Eersterivier has the lowest percentage employed residents using a car to commute to work, and the lowest percentage employed residents using public transport to commute to work.

Table 1: Characteristics of railway stations and their park-and-ride facilities

	Brackenfell	Kraaifontein	Kuilsrivier	Melton Rose	Eersterivier	Eikenfontein
STATION DEMOGRAPHICS						
Location	William Dabs street, Brackenfell	12th Ave, Kraaifontein	Grove street, Kuilsrivier	Melton Street, Blue Downs	Station road, Eersterivier	9th Ave, Eikendal
Straight line distance to CBD	24.77 km	28.87 km	23.42 km	28.24 km	29.63 km	27.47 km
Straight line distance to nearest station	3.14 km	1.73 km	5.83 km	1.58 km	1.73 km	1.58 km
Straight line distance to the nearest freeway	2.40 km	0.80 km	6.64 km	5.37 km	4.24 km	1.36 km
PARKING CHARACTERISTICS						
Received park-and-ride upgrade	Yes	Yes	Yes	No	No	No
Amount of parking bays before upgrade (1)	355	210	182	55	100	103
Amount of parking bays after upgrade (1)	455	210	327	55	100	103
Parking location relative to transit service	<100m	<100m	<100m	<100m	<100m	<100m
Parking tariff	Free of charge	Free of charge	Free of charge	Free of charge	Free of charge	Free of charge
SERVICE CHARACTERISTICS						
Average frequency of transit service (04:00 - 08:00) (2)	12 min	12 min	13 min	13 min	13 min	14 min
Average frequency of transit service (08:00 - 16:00) (2)	35 min	34 min	27 min	27 min	27 min	35 min
Average frequency of transit service (16:00 - 20:00) (2)	19 min	16 min	19 min	19 min	18 min	19 min
Average travel time to CBD (2)	45 min	53 min	44 min	53 min	57 min	50 min
Amount of boarding passengers (Weekday) (3)	3522	6411	7341	7192	11791	3013
Amount of aligning passengers (Weekday) (3)	3756	5503	6962	6086	12683	2993
Service tariff to CBD (Metro Plus single ticket) (2)	R8.50	R8.50	R8.50	R8.50	R8.50	R8.50
PARK-AND-RIDE CATCHMENT AREA CHARACTERISTICS						
% employed using a car (4)	75 - 100%	52 -74%	26 - 51%	27 - 51%	27 - 51%	26 - 51%
% employed using public transport (4)	7 - 26%	27 - 51%	7 - 26%	52 - 68%	52 - 68%	27 - 51%
Population size (5)	35679	41513	44794	36742	29682	35679
Household income level (5)	R76801 - R307200 (57%)	R76801 - R307200 (44%)	R76801 - R307200 (41%)	0 - R19200 (52%)	R19201 - R76800 (57%)	R76801 - R307200 (57%)

1 City of Cape Town representatives
2 www.capemetrorail.co.za
3 PRASA representative (2008 ridership data)
4 www.capetown.gov.za (ITP 2006 – 2011)
5 www.capetown.gov.za (2001 census data)

Figure 2.1 Brackenfell station precinct

Number of bays before upgrade	355
Number of bays during upgrade	355
Number of bays after upgrade	455
Percent increase in parking bays	28%

Figure 2.2 Locality map

Figure 2.3 Before upgrade

Figure 2.4 After upgrade

Figure 3.1 Kraaifontein station precinct

Number of bays before upgrade	210
Number of bays during upgrade	210
Number of bays after upgrade	210
Percent increase in parking bays	0%

Figure 3.2 Locality map

Figure 3.3 Before upgrade

Figure 3.4 After upgrade

Figure 4.1 Kuilsrivier station precinct

Number of bays before upgrade	182
Number of bays during upgrade	182
Number of bays after upgrade	327
Percent increase in parking bays	80%

Figure 4.2 Locality map

Figure 4.3 Before upgrade

Figure 4.4 After upgrade

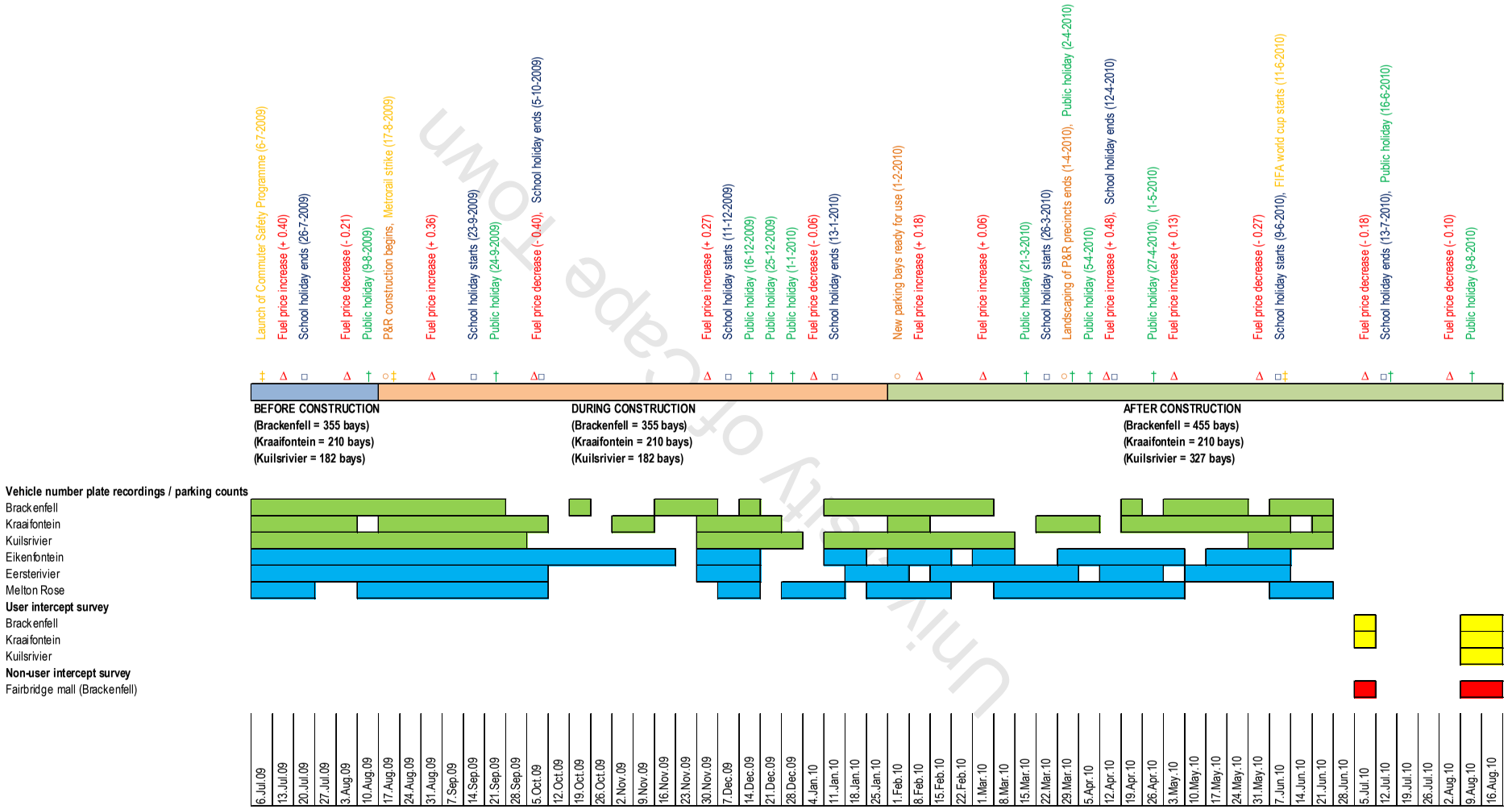


Figure 5. Timeline of events

3.5 Timeline of events

The monitoring period in which data were to be collected comprised of three main periods (see figure 5). These included firstly the period before construction were to take place (6 June 2009 till 16 August 2009), secondly the period during construction (17 August 2009 till 31 January 2010) and thirdly the period after construction (1 February 2010 till 16 August 2010).

The first data collection method, i.e. parking counts and vehicle number plate recordings commenced in the period before construction and continued to the end of the monitoring period (6 June 2009 till 27 June 2010). The second data collection method, i.e. user and non-user intercept surveys, were undertaken in the period after construction firstly by a pilot survey (5 July 2010) and then the main survey (9 August 2010 till 22 Augusts 2010).

During these periods certain events also took place that might or might not have had an impact on the usage of park-and-ride facilities, or might have had an impact on the data that was collected in these periods. These events included *inter alia*:

- School holidays;
- Public holidays;
- Fuel price increases and decreases;
- Employee union strikes;
- FIFA Soccer World Cup;
- Park-and-ride facility upgrade construction

3.6 Summary and conclusion

Three affected rail stations, i.e. Brackenfell; Kraaifontein and Kuilsrivier and three control stations, i.e. Eikenfontein; Eersterivier and Melton Rose were chosen to form part of the dissertations case study. These facilities was selected to provide the best results from the developed data collection methods which could be undertaken within the research projects budget and timeframe. As a result of the upgrades, the number of available park-and-ride bays increased from 355 to 455 at Brackenfell station and from 182 to 327 at Kuilsrivier station, while the number of bays at Kraaifontein; Eikenfontein; Eersterivier and Melton Rose stations remained the same at 210, 103, 100 and 55 respectively.

Reflecting on the characteristics of the affected and control stations all the park-and-ride facilities are within six km of the nearest station. The use of all of the park-and-ride facilities is free of charge against the City of Cape Town's parking bays who charges users for its usage. All the facilities are located within 100m from the rail station. The public transport operating times are more frequent during peak hours than during off-peak hours while at the same time providing faster journey times than private transport. The fare for using the railway service is cheap in comparison to travelling into town by car

The monitoring period comprised of three main periods, i.e. the period before construction were to take place where parking counts and vehicle registration number plate recordings began (6 June 2009 till 16 August 2009), the period during construction where a user and non-user intercept survey took place (17 August 2009 till 31 January 2010) and the period after construction (1 February 2010 till 16 August 2010). These periods were also highlighted by events such as school and public holidays; fuel price increases and decreases; employee union strikes, FIF Soccer World Cup and park-and-ride facility upgrade construction.

CHAPTER 4

METHOD

4.1 Introduction

As stated in previous chapters, a travel demand management intervention, i.e. park-and-ride facility upgrades, was identified which would be implemented by the City of Cape Town in 2009 to 2010. This dissertation will determine the extent to which the upgrade of selected rail-based park-and-ride facilities in Cape Town's northern suburbs impacted commuter travel behaviour, and, at the same time develop methods to measure and analyse these impacts. In chapter 2 a literature review was presented to provide a clear understanding of park-and-ride facilities, and to provide benchmark information against which information collected in the dissertation can be compared. Chapter 3 then defined the dissertation's case study and the monitoring period over which data was to be collected.

The purpose of this chapter is to discuss the data collection methods used in terms of the method undertaken; its objectives; its sample size design and limitations in order to assess the impacts of the park-and-ride facility upgrades.

This chapter starts by discussing the data collection techniques used in the study, in the form of vehicle counts and number plate recordings. These techniques are discussed in terms of the method undertaken; its objectives; its sample size design as well as the limitations of the method. The chapter continues by discussing firstly the user and secondly the non-user intercept survey in terms of the method undertaken; its objectives; its sample size design as well as the limitations of the method.

4.2 Vehicle counts and number plate recordings

4.2.1 Description of method undertaken

In order to accurately assess the impact of the park-and-ride upgrades, data would have had to be collected in the period before construction was to take place, the period during construction and a period after the park-and-ride facilities upgrades were completed. This was calculated to be a costly undertaking which would have cut substantially into the research data collection budget. While the researcher was searching for a person to be employed to collect the vehicle registration number data on a daily basis for them at the affected rail stations, i.e. Brackenfell and Kraaifontein, the researcher came to the knowledge that the SAPS had an new initiative called the "Commuter Safety Programme" that places volunteers at the affected park-and-ride facilities as to decrease the current car theft that occurs at these facilities through visual enforcement who already collected vehicle number plate data everyday (see annexure E for survey template used). This initiative by the SAPS has proved to be highly successful with car theft almost decreasing by 90%. It must be noted that there was no communicating between the SAPS, the implementing agency of the park-and-ride facilities and the City of Cape Town about this initiative. Meetings were held with the SAPS and an agreement was made whereby the researcher may use the vehicle registration number plate data that the "Commuter Safety Programme" collects. Additionally the SAPS agreed to give the researcher four additional park-and-ride facilities vehicle registration numbers. Thus car registration number plate data were received for the three affected park-and-ride facilities, i.e. Brackenfell, Kraaifontein and Kuilsrivier, as well as

Eikenfontein, Eersterivier and Melton Rose and park-and-ride facilities who did not receive construction upgrades.

This arrangement between the researcher and the SAPS, although adding tremendously to the success of the project, did not always go as planned and some of the data could not be retrieved from the SAPS and data on some days were not recorded by the "Commuter Safety Programme". The researcher then stepped in and a new arrangement was made that entailed the researcher overseeing the recording of this data for the rest of the research projects timeframe. Unfortunately at the end of this research project timeframe the "Commuter Safety Programme" initiative ran into some administration problems whereby the guards at the stations refused to record the parked vehicles registration numbers. It was then decided to draw this data collection method to an end as the quality of the information collected could not be guaranteed.

With some time periods missing, parked vehicle number plate data were collected at the stations during the before period (6 June to 16 August 2009), construction period (17 August 2009 to 31 January 2010), and after period (1 February to 27 June 2010). The relatively shorter before period (two and a half months) was due to data collection only starting at this point. The vehicle registration number plate data were collected each workday between 08:00 and 17:00 by the SAPS 'Commuter Safety Programme' and excluded weekdays. The data was captured into a customised Microsoft Excel database (see annexure F) for analysis.

4.2.2 Objectives of method

The recording of vehicle registration numbers would be used to firstly determine the actual usage of the park-and-ride facilities at the affected railway stations in the northern suburbs of Cape Town. Secondly through this method the composition of the park-and-ride users will be determined. This will entail assessing which of these users are first-time users ('new users'), continuing users from the previous week ('repeating users'), and users who had stopped using the facility in the previous week(s) but had returned in the current week ('returning users'). Lastly this method will determine the average frequency of usage of the park-and-ride facilities by the park-and-ride users and determine if park-and-ride users from one park-and-ride facility also use the park-and-ride facility of another railway station.

4.2.3 Sample size design

In order to accurately assess the impact the park-and-ride upgrades had on the increased usage of these facilities, a census of the affected park-and-ride facilities was warranted instead of recording vehicle registration numbers at random. For this reason a sample size could not be defined beforehand but only after the data collection method was completed. In total 6,501 vehicle's usage of the three affected and control park-and-ride facilities was collected over a period of 12 months.

4.2.4 Method limitation

The quality of the data collected by security guards was the biggest concern in using this method. To address this, the reliability of the data collected by security guards was verified through a comparison with data collected by the researcher, and every month data were checked for inconsistencies. An analysis of the adequacy of the daily 08h00 and 17h00 data collection period was also undertaken, and it was found that this period was sufficiently long to capture the majority of vehicles using the park-and-ride facilities. It was observed that 94% of daily users arrive between 06h00 and 08h30, of whom 35% depart between 14h00 and 17h00 and 59% depart between 17h00 and 19h00.

4.3 User intercept survey

4.3.1 Description of method undertaken

In the week before user intercept data was to be collected 10 interviewers, from an independent transport survey company, were trained in undertaking the survey. In this session the survey questions and method was explained to the interviewers. To test the survey a (n=40) pilot survey was conducted on 2 June 2009 at Brackenfell railway station (after the school holiday and FIFA World Cup), in which no significant problems were encountered. The interviewers then returned for a second training session were any problems encountered with the survey or method were corrected or/and adjusted. The main (n=360) user intercept survey was undertaken at the park-and-ride facilities of the Brackenfell and Kraaifontein stations with the inclusion of Kuilsrivier station due to a low utilisation period between 9 and 20 August 2010.

In summary 10 trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride users on their return trip for the day, between 15h00 and 18h30. The survey was designed to take no longer than 10 minutes to complete. An elaborate system was put in place to ensure that each interview that was undertaken provided the researcher with the best quality questionnaires. The completed questionnaires were firstly checked by the interviewer to ensure that all questions supposed to be asked were asked and secondly by. Lastly the questionnaires were checked by the researcher and if any questionnaires were not of the correct quality it was discarded and a new interview were undertaken in its place. Questionnaire responses were coded and captured in a flat-line database for analysis (see annexure A and B).

4.3.2 Objectives of method

The survey envisaged to ask park-and-ride users firstly socio-demographic questions to determine the shape of the park-and-ride catchment area, and who the users are in terms of race, occupation, age, household size and car ownership. Secondly the researcher wanted to determine if the park-and-ride user who is interviewed is a new user or continuous user. If the park-and-ride user is a new user the researcher would like to ask them how did they used to travel before starting using the park-and-ride facility and what was the reason for them using the facility and if there was any change in their life style that made them change their way of travelling. It would also be valuable to find out if any aspects of their daily travel behaviour changed as a result of using the park-and-ride facilities and lastly how they became aware of the facilities. If the park-and-ride user is a continuous user they will be asked how they travelled before using the railway service and their reasons for using the railway and if there was any change in their life style that made them using the railway service. Lastly the researcher would like the park-and-ride users to rate the importance of certain park-and-ride service attributes and their satisfaction with these attributes.

4.3.3 Sample size design

All users of the park-and-ride facilities identified on the survey days were selected (i.e. a census), and interviewers were instructed to make alternative arrangements if the interview could not be undertaken at the point of first contact. Refusal rates were, however, in the region of 20%. Despite attempts to interview all users, and taking into consideration the rate of refusal, when compared to the parking count data at the affected stations during the after period it is estimated that only ±66% of all likely users in the survey period were interviewed. The sampling bias this may have introduced is unclear. The reason for missing these users is presumably because they alighted the train before or after the 15h00 and 18h30 intercept period, and were therefore not present.

4.3.4 Method limitation

A limitation of this method was the willingness of respondents to take part in the survey. To counter against this the questionnaires to be used were made as short as possible but still included critical questions to meet the survey's objectives. A further problem foreseen was the dates that the survey would take place on, because it cannot without certainty be estimated when the park-and-ride facilities will have a high utilisation rate to intercept most park-and-ride users. To address this, the researcher decided that in the instance that data was collected in a low utilisation period, Kuilsrivier station would also be included to be surveyed as it also received park-and-ride upgrades.

4.4 Non-user intercept survey

4.4.1 Description of method undertaken

Because the parking count data indicated that impacts at affected stations were uneven, a further (n=400) survey of non-users within their park-and-ride catchment was conducted to assess how effectively the park-and-ride upgrades had been marketed.

As in the user intercept survey in the week before data was to be collected 10 interviewers, from an independent transport survey company, was trained in undertaking the non-user intercept survey. In this session the survey questions and method was explained to the interviewers. To test the survey a (n=40) pilot survey was conducted on Saturday 28 June 2010, in which no significant problems were encountered. The interviewers then returned for a second training session were any problems encountered with the survey or method were corrected or/and adjusted. The main interviews (n=360) were conducted at a suitably located shopping centre (Fairbridge Mall) on two Saturdays (09h00 to 14h00, 7 and 14 August 2010).

In summary 10 trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride non-users who lived in the catchment area and worked somewhere accessible by train. The survey was designed to take no longer than 5 minutes. Interviews were undertaken at a shopping centre that was in Brackenfell, Kraaifontein and Kuilsrivier's park-and-ride catchment area (see annexure C and D)

4.4.2 Objectives of method

It was envisaged to ask non-users of the park-and-ride facilities questions to determine how their socio-demographic profile differs from users of the park-and-ride facilities. Because the main reason for undertaking the non-user intercept survey will be to determine how successful the marketing of the newly upgraded park-and-ride facilities is, the non-users will be asked if they are aware of the upgraded facilities. If they are the researcher would like to ask how they became aware of these facilities and what the main reason is for them not using the park-and-ride facility and the railway service. If the non-user is not aware of the upgraded park-and-ride facilities it is envisaged to ask them if they would be interested in using these facilities and the railway service. If the respondent indicates that he/she would not use the facility and the railway service they would be ask to give a reason why not.

4.4.3 Sample size design

Given that the target population of possible park-and-ride users is estimated to be in the region of 15,000 (assuming 1.5 commuters in 10,000 households), the margin of error of a randomly selected respondent sample of 400 is estimated to be five percent at a 95% confidence level.

4.4.4 Method limitation

As in the user intercept survey a limitation of this method was the willingness of respondents to take part in the survey. To counter against this the questionnaires to be used were made as short as possible but still included critical questions to answer the objective's questions.

4.5 Synthesis of data collection methods

As discussed in the earlier literature review chapter, in order for a change in travel behaviour to be observed (i.e. increase or decrease in utilisation of park-and-ride facilities), vehicle counts and number plate recording would have to be collected before and after the upgrade of the park-and-ride facilities. This would have to be collected at affected (or 'experiment') stations where the upgrade of park-and-ride facilities are to take place, as well as include a 'control' group of stations to assist in assessing whether any utilisation changes observed across the before and after periods were the result of external factors.

The use of a user intercept survey will assist in explaining the cause of any change in utilisation at the affected park-and-ride facilities. A non-user intercept survey would assist in explaining why little change at the affected park-and-ride facilities might be found.

4.6 Summary and conclusion

With some time periods missing, parked vehicle number plate data were collected at the affected stations during the before period (6 June to 16 August 2009), construction period (17 August 2009 to 31 January 2010), and after period (1 February to 27 June 2010). The relatively shorter before period (2.5 months) was due to data collection only starting at this point. Data were collected between 08h00 and 17h00 on weekdays by security guards working for the South African Police Service's Commuter Safety Programme. The number plates of all vehicles parked in the park-and-ride facility were recorded each day. A total of 6,501 vehicles were tracked at the six park-and-ride facilities. The reliability of the data collected by security guards was verified through a comparison with data collected by the researcher, and every month data were checked for inconsistencies. An analysis of the adequacy of the daily 08h00 and 17h00 data collection period was also undertaken, and it was found that this period was sufficiently long to capture the majority of vehicles using the park-and-ride facilities. It was observed that 94% of daily users arrive between 06h00 and 08h30, of whom 35% depart between 14h00 and 17h00 and 59% depart between 17h00 and 19h00. A spot parking count was undertaken by recruited fieldworkers on 7 December 2010 to establish whether any significant changes in utilisation had occurred over the period since 28 July when daily recordings ceased.

The (n=400) user intercept survey was undertaken at the park-and-ride facilities of the three affected stations between 9 and 20 August 2010. Ten trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride users on their return trip for the day, between 15h00 and 18h30. The survey was designed to take no longer than 10 minutes to complete. The questionnaire (in English and Afrikaans) included questions on respondent socio-demographics, household characteristics, trip characteristics, patterns of behaviour before park-and-ride upgrade, and satisfaction ratings of the park-and-ride facility. New park-and-ride users were asked how they travelled before using the park-and-ride facility, and why they began using the facility. A (n=40) pilot survey was conducted on 2 June 2009 (after the school holiday and FIFA World Cup), in which no significant problems were encountered. All users of the park-and-ride facilities identified on the survey days were selected (i.e. a census), and interviewers were instructed to make alternative arrangements if the interview could not be undertaken at the point of first contact. Refusal rates were, however, in the region of 20%. Despite attempts to interview all users, and taking into consideration the rate of refusal, when compared to the parking count data at the affected stations during the after

period it is estimated that only ±66% of all likely users in the survey period were interviewed. The sampling bias this may have introduced is unclear. The reason for missing these users is presumably because they alighted the train before or after the 15h00 and 18h30 intercept period, and were therefore not present. Questionnaire responses were coded and captured in a flat-line database.

Because the parking count data indicated that impacts at affected stations were uneven, a further (n=400) survey of non-users within their park-and-ride catchment was conducted to assess how effectively the park-and-ride upgrades had been marketed. Ten trained interviewers conducted interviews, in English and Afrikaans, with park-and-ride non-users who lived in the catchment area and worked somewhere accessible by train. Interviews were conducted at a suitably located shopping centre (Fairbridge Mall) on two Saturdays (09h00 to 14h00, 7 and 14 August 2010). The survey was designed to take no longer than five minutes. The questionnaire (in English and Afrikaans) included questions on respondent socio-demographics, awareness of the park-and-ride facilities, media through which respondents became aware of the facilities, willingness to use the facilities, and reasons for not utilising, or not wishing to utilise, the facilities. A (n=40) pilot survey was conducted on Saturday 28 June 2010, in which no significant problems were encountered. Given that the target population of possible park-and-ride users is estimated to be in the region of 15,000 (assuming one and a half commuters in 10,000 households), the margin of error of a randomly selected respondent sample of 400 is estimated to be five percent at a 95% confidence level.

CHAPTER 5

RESEARCH FINDINGS

5.1 Introduction

The previous chapters laid the foundation for data collection to be undertaken. Chapter 2 provided an understanding of park-and-ride facilities and benchmarking information. Chapter 3 described the park-and-ride case in Cape Town. Chapter 4 discussed the study's research method.

The purpose of this chapter is to present the main research findings in terms of the three data collection sources, which were discussed in the previous chapter. These are vehicle counts and number plate recordings, user intercept surveys and lastly non-user intercept surveys.

This chapter starts by presenting findings from vehicle counts and number plate recordings in terms of the utilisation of the affected and control park-and-ride facilities; variation in lot composition and individual utilisation patterns; and switching between the park-and-ride facilities. It continues by presenting findings from the user intercept survey in terms of new users and continuous users to the affected park-and-ride facilities as well as the park-and-ride facilities catchment areas. This chapter concludes by presenting findings from the non-user intercept survey.

5.2 Vehicle counts and number plate recordings

5.2.1 Park-and-ride facility utilisation

The vehicle number plate data revealed dissimilar before and after impacts across the affected stations (see table 2). Brackenfell station experienced an increase of 13% in the after period compared to the before period, which, when compared to the mean 14% increase observed across the three control stations, suggests that the park-and-ride upgrade and expansion (100 extra bays) had little or no impact. Kraaifontein station experienced an increase of 27% in the after period, which, when compared to the control stations, suggests that an increase of around 13% may be attributed to the park-and-ride upgrade. Kuilsrivier station experienced an increase of 44% in the after period, which, when compared to the control stations, suggests that an increase of around 30% may be attributed to the park-and-ride upgrade and expansion (145 extra bays). Such a significant increase can perhaps be attributed to a mean 115% over-capacity utilisation prior to upgrade (see figure 6), and associated latent demand. The spot parking counts conducted on 7 December 2010 at all stations did not reveal any significant change following the discontinuation of longitudinal data collection in June 2010 (see figures 6-9). The data suggests that with a weighted mean before vs. after increase of 29% at the affected stations combined, compared with a 14% increase at the control stations, the park-and-ride improvements could have resulted in a 15% increase in users.

Table 2. Before and after daily park-and-ride facility utilisation, by affected and control rail stations (n=6,501)

		Affected rail stations				Control rail stations			
		Brackenfell	Kraaifontein	Kuilsrivier	Sub-total	Eikenfontein	Eersterivier	Melton Rose	Sub-total
Before	Minimum	120	55	62	**237**	47	64	25	**136**
	Maximum	241	97	298	**636**	104	97	55	**256**
	Mean	186	74	210	**471**	71	84	36	**191**
	Standard deviation	39	11	72		18	9	9	
During	Minimum	43	25	45	**113**	40	46	12	**98**
	Maximum	292	128	347	**767**	105	100	60	**265**
	Mean	163	71	196	**430**	79	80	41	**200**
	Standard deviation	68	20	68		19	12	12	
After	Minimum	83	37	58	**178**	51	56	22	**129**
	Maximum	327	161	477	**965**	104	117	72	**293**
	Mean	209	94	303	**607**	82	91	46	**219**
	Standard deviation	57	29	139		16	12	10	
Change in daily mean	Before vs. after	23	20	93	**136**	10	7	10.	**28**
	%	*(+) 13*	*(+) 27*	*(+) 44*	***(+) 29***	*(+) 14*	*(+) 9*	*(+) 28*	***(+) 14***
	During vs. after	47	23	107	**177**	2	12	5	**19**
	%	*(+) 29*	*(+) 32*	*(+) 55*	***(+) 41***	*(+) 3*	*(+) 15*	*(+) 13*	***(+) 10***
	Before + during vs. after	35	22	100	**156**	6	9	8	**23**
	%	*(+) 20*	*(+) 30*	*(+) 49*	***(+) 35***	*(+) 8*	*(+) 12*	*(+) 20*	***(+) 12***

Note:
1. The mean and standard deviation values presented in this table exclude data for days on which external events (e.g. public holidays, public transport employee strikes) resulted in atypical utilisation.

The daily utilisation presented in figure 6 indicates a highly variable pattern, affected by a range of external factors such as school holidays, public holidays, public transport employee strikes, fuel price changes and even the weather (the methodological implications of this are discussed in Chapter 7). This variability is reflected in a wide range between minimum and maximum values, and large standard deviation values (see table 2). The figure illustrates that daily utilisation rates tend to be higher at the beginning of the week, declining steadily as the week draws to a close. The reasons for this daily variation are unclear.

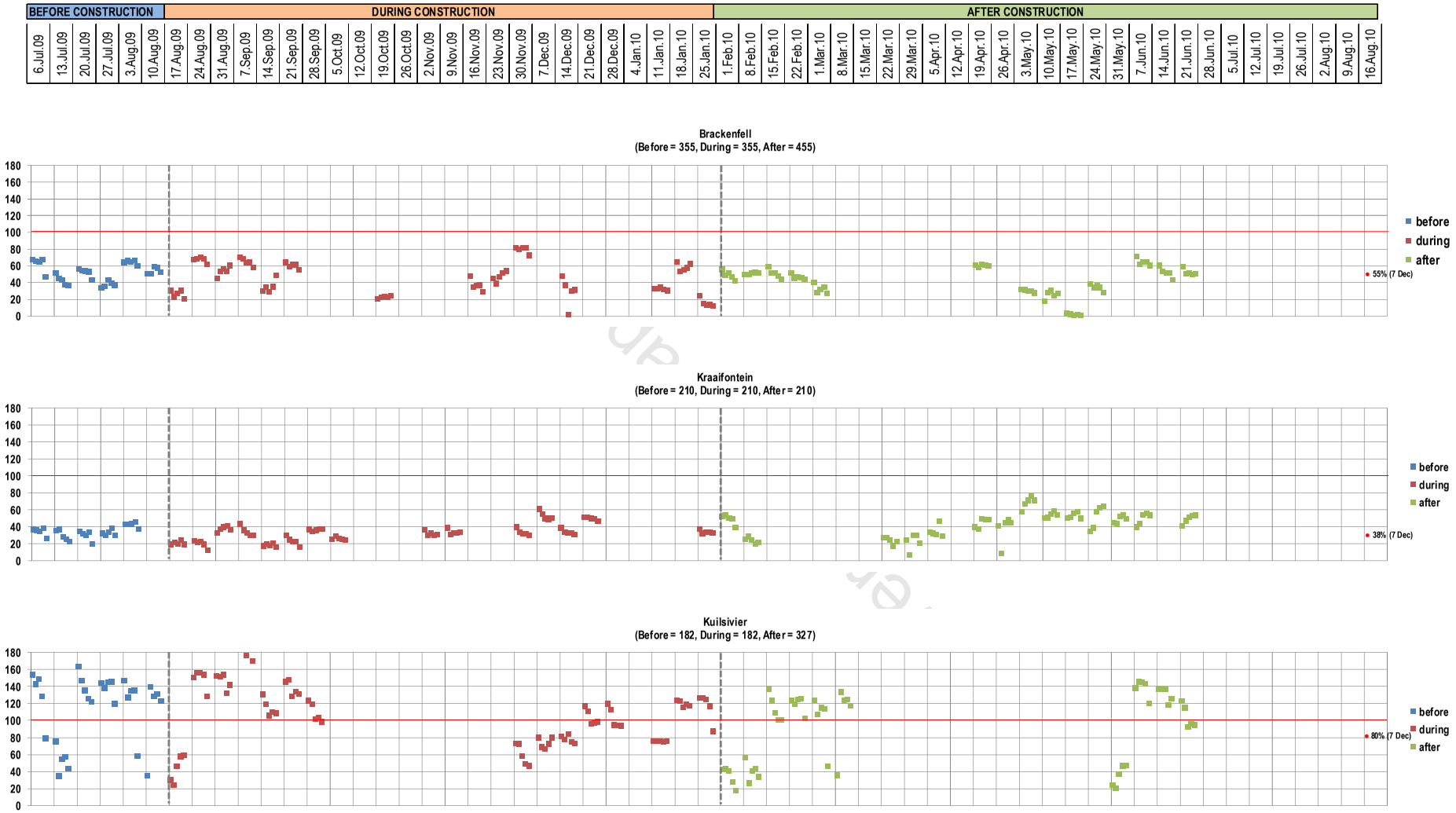


Figure 6. Before and after mean daily park-and-ride facility utilisation, by affected station (percentage, n=3,665)

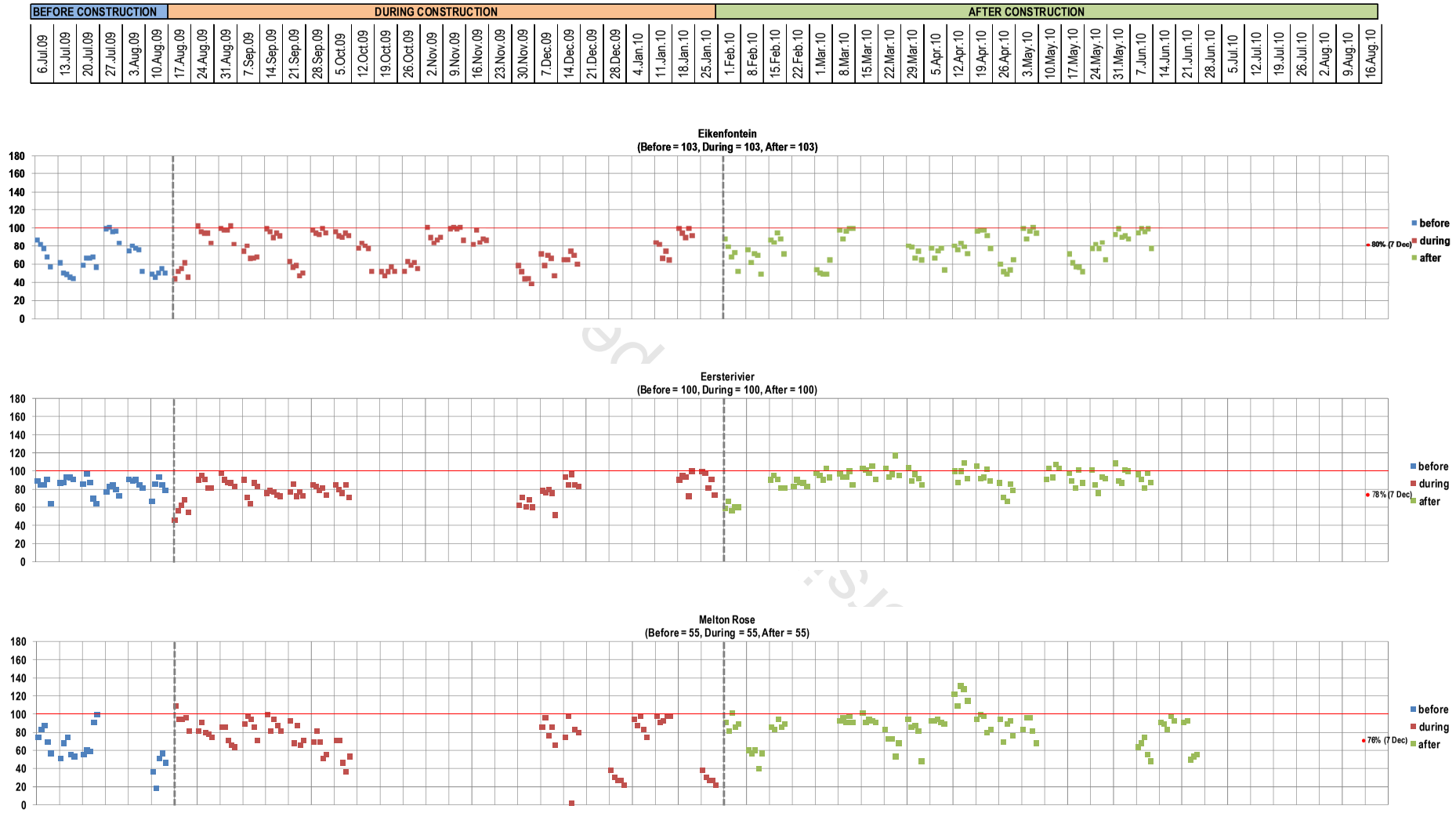


Figure 7. Before and after mean daily park-and-ride facility utilisation, by control station (percentage, n=2,836)

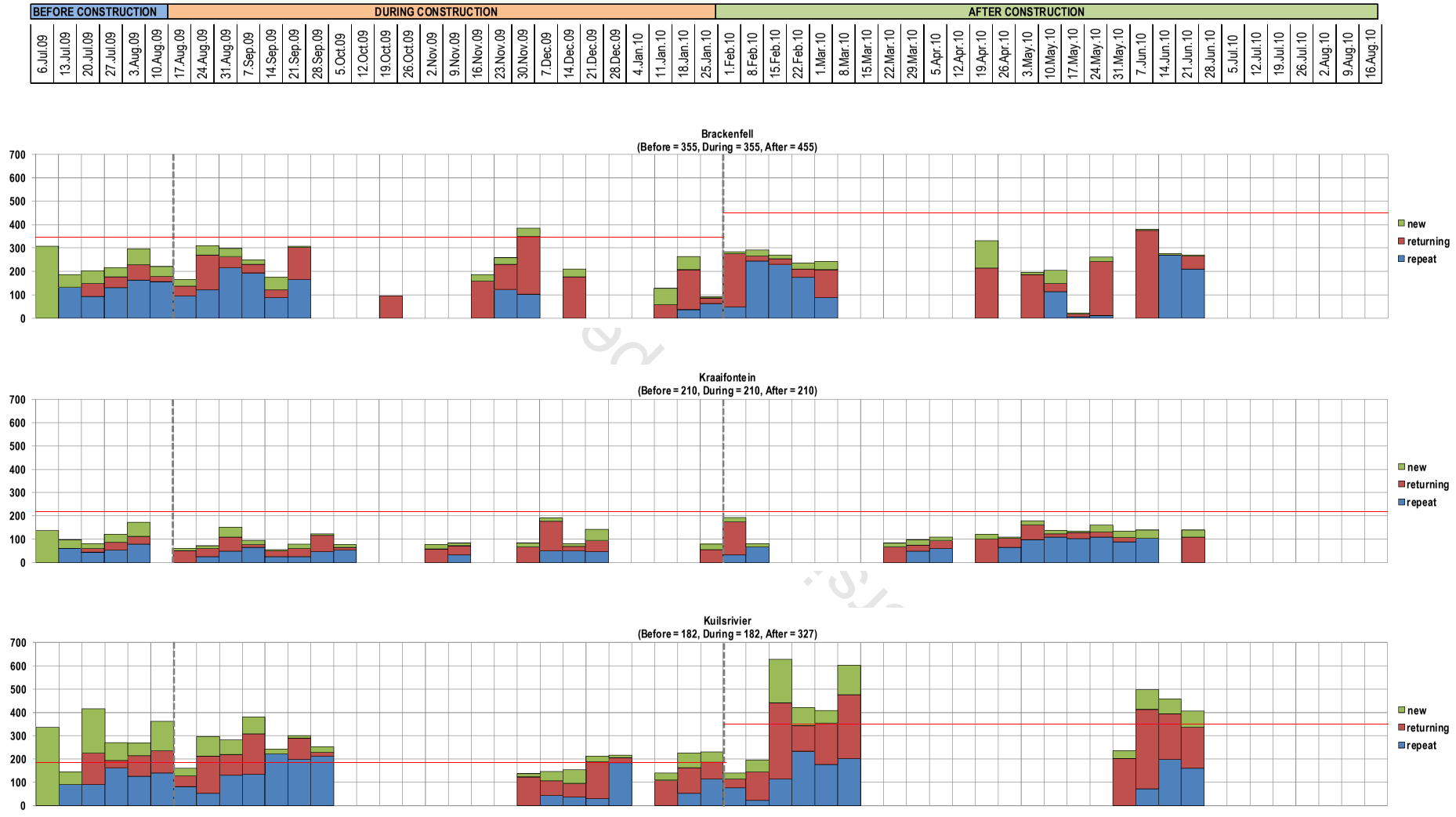


Figure 8. Weekly park-and-ride utilisation, by affected station and by user type (count, n=3,665)

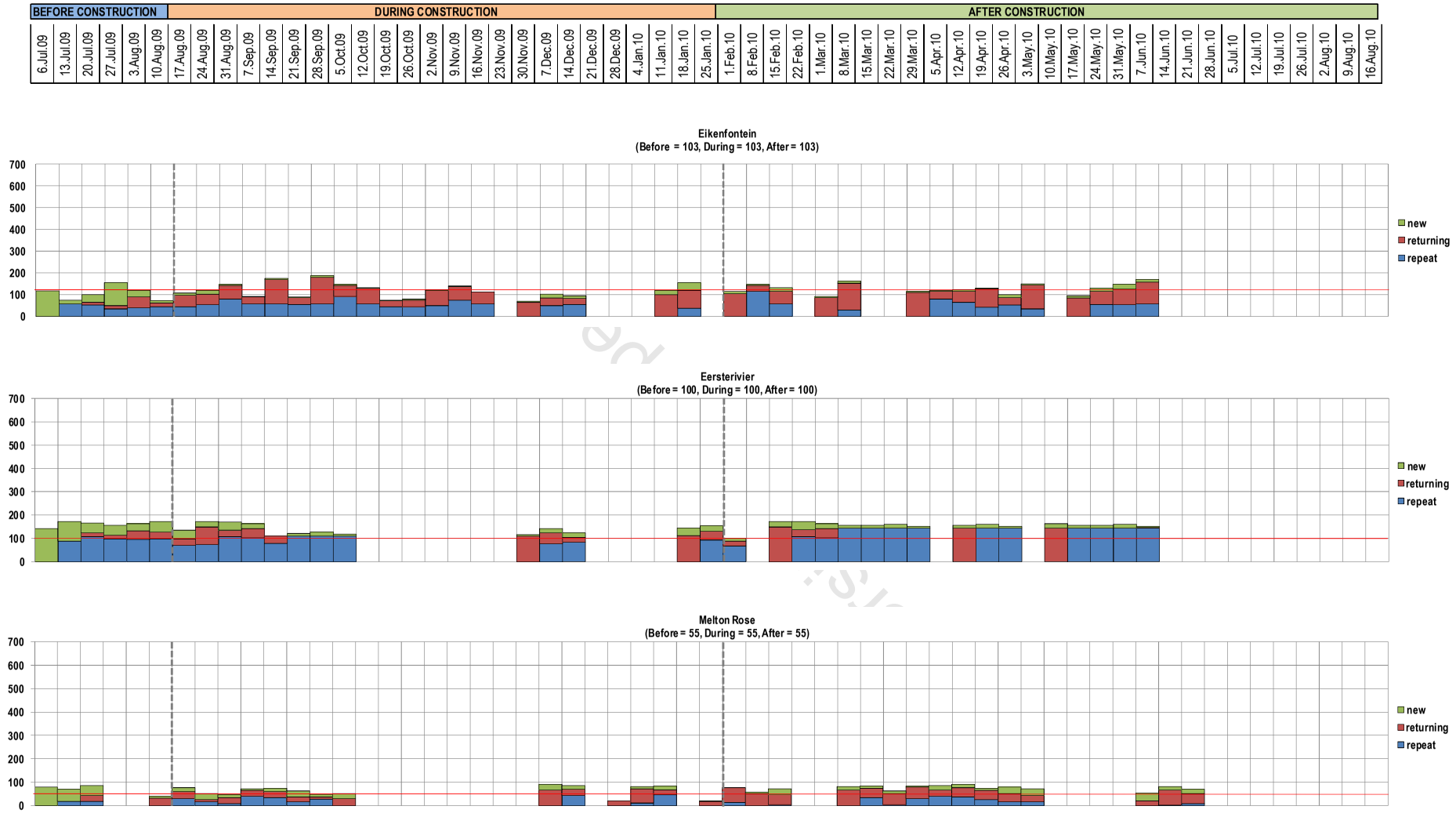


Figure 9. Weekly park-and-ride utilisation, by control station and by user type (count, n=2,836)

5.2.2 Variation in lot composition and individual utilisation patterns

The tracing of individual vehicles in the number plate data over time revealed a high rate of intra-personal variability in behaviour patterns (see figures 8-9). It was found that from week to week there are first-time users ('new users'), continuing users from the previous week ('repeating users'), and users who had stopped using the facility in the previous week(s) but had returned in the current week ('returning users'). This variation indicates that a phenomenon known as 'churn' – observed in the composition of traffic streams and public transport passenger flows (see, for instance, Del Mistro and Behrens 2008, Cherrett and McDonald 2002, and Hermant and Bester 2008) – is also present in park-and-ride utilisation. 'Churn' refers to a process in which individuals make reciprocal changes in their travel behaviour, so that in aggregate form the system exhibits similar characteristics and a false stability over time (e.g. in terms of volume, density and speed). Aggregate or system-wide change is the result of asymmetry in 'churning' individual decisions – labelled by Goodwin (1999) as 'asymmetric churn'. The methodological implications of this for the measurement park-and-ride impacts are discussed in chapter 7.

'Churn' is observable in both the affected and control stations and cannot be regarded as a direct impact of the park-and-ride upgrades. No statistical difference was found in the magnitude of this phenomenon across the affected and control stations. The data also revealed no significant differences in the number of times individuals used the park-and-ride facilities per week in the before, construction and after periods.

Comparison of the vehicle number plate and user survey data suggests that the vehicle number plate data offer a more reliable representation of park-and-ride utilisation patterns. It was found that respondents reported higher frequencies of use per week, than was observed in number plate recordings (suggesting a tendency of respondents to overestimate the regularity of personal behaviour in retrospective surveys).

5.2.3 Switching between park-and-ride facilities

Comparison of vehicle number plate recordings across the different rail stations indicated that in the before period some park-and-ride users utilised more than one facility on a regular basis. The other facility(ies) was typically within a six kilometre range. In the construction period this switching between facilities increased, as users sought close alternatives to avoid inconvenience. In the after period switching between facilities reduced again and stabilised (see table 3). The switching between lots outside of the construction period highlights the methodological importance of assessing utilisation impacts at stations in geographical clusters rather than on an individual basis.

Table 3. Switching between park-and-ride facilities (n=6,501)

Percentage of cars switching between station's park-and-ride facilities (6 June till 16 August 2009)

%		TO Brackenfell	Kraaifontein	Eikenfontein	Kuilsrivier	Eersterivier	Melton Rose
FROM	Brackenfell (n = 562)		1	2	1	0	0
	Kraaifontein (n = 292)	2		20	0	0	0
	Eikenfontein (n = 316)	4	18		0	0	0
	Kuilsrivier (n = 832)	1	0	0		1	4
	Eersterivier (n = 385)	0	0	0	1		2
	Melton Rose (n = 179)	0	0	0	21	5	

Percentage of cars switching between station's park-and-ride facilities (17 August till 31 January 2010)

%		TO Brackenfell	Kraaifontein	Eikenfontein	Kuilsrivier	Eersterivier	Melton Rose
FROM	Brackenfell (n = 433)		7	3	1	0	0
	Kraaifontein (n = 270)	14		12	1	0	0
	Eikenfontein (n = 164)	5	14		1	5	0
	Kuilsrivier (n = 588)	1	1	1		1	1
	Eersterivier (n = 255)	0	0	3	1		2
	Melton Rose (n = 200)	0	0	0	1	5	

Percentage of cars switching between station's park-and-ride facilities (1 February till 27 June 2010)

%		TO Brackenfell	Kraaifontein	Eikenfontein	Kuilsrivier	Eersterivier	Melton Rose
FROM	Brackenfell (n = 335)		1	0	1	0	0
	Kraaifontein (n = 279)	2		0	0	0	0
	Eikenfontein (n = 151)	2	4		0	0	0
	Kuilsrivier (n = 773)	1	0	0		1	0
	Eersterivier (n = 249)	0	0	0	1		0
	Melton Rose (n = 238)	0	0	0	1	1	

5.3 User intercept survey

Analysis of the (n=400) intercept survey data indicated that park-and-ride users at the affected stations were mostly male (60%), aged 25-50 years (90%), white-collar workers (70%), and 'Coloured' (45%) and 'White' (38%) (see table 4). Ninety-seven percent of users owned a car or had access to a car, while the remaining three percent rode with another user who had the use of a vehicle. Interestingly, from the perspective of vehicle kilometres travelled reduction, 30% of respondents indicated that they drove to the park-and-ride facility alone, 48% indicated they drove with one other person, and 19% indicated they drove with two other people. Work trips accounted for 96% of trip purposes. The train service was identified by 84% of users to be the mode covering the longest stage of their trip.

Table 4: Park-and-ride users by gender and race (n = 400)

	Black	Coloured	Indian	White	Other	Non-Response	Total
Male	42	104	1	92	1	0	240
%	*18*	*43*	*0*	*38*	*0*	*0*	*100*
Female	23	77	0	60	0	0	160
%	*14*	*48*	*0*	*38*	*0*	*0*	*100*
Non-response	0	0	0	0	0	0	0
%	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total	65	181	1	152	1	0	400
%	*16*	*45*	*0*	*38*	*0*	*0*	*100*

5.3.1 New users

Data analysis indicated that 89% of users were park-and-ride users before the upgrades were completed (i.e. before 1 February 2010), and thus only 11% of the users were new users (see table 5). Of this 11% (or 43) new users, 67% were previously car users (including both car drivers and passengers),16% were train users who did not use a park-and-ride facility, nine percent were minibus-taxi users, and one percent were bus users, which indicates that the park-and-ride improvements may have had a small but discernable effect on mode choice. This proportion of new users is inconsistent with the parking count data, which would suggest that new users should be in the region of 22% of the after user group (see table 2). A possible cause of this discrepancy might be more frequent weekly use by continuing users in the after period, and thus higher aggregate utilisation in this period without a proportionate increase in new users, but this was not readily apparent in the vehicle tracing analysis.

With regard to new and continuing user satisfaction with the upgraded park-and-ride facilities, 82% were dissatisfied with the fact that their vehicles were unprotected from the weather, 48% were dissatisfied with the number of security personnel, 43% were dissatisfied with the duration of the security service provided which did not cover early arrivals and late departures, and 24% were dissatisfied with the quality of service provided by security guards. Ninety-eight percent of the respondents indicated that they will keep using the park-and-ride facilities in the future.

The reasons cited by new users for why they started using the park-and-ride facilities related to reducing travel costs (55%), changing jobs (28%), and moving house (seven percent).

With regard to changes in travel patterns, 47% of new users started leaving home later in the morning to commute to work, 65% arrived home earlier from work, 72% experienced shorter travel times, and 86% indicated that their cost of travelling had decreased (see table 6). With regard to how they became aware of the park-and-ride facility, 42% became aware through family and friends, 33% saw the new road signage outside the railway station, and 14% had seen newspaper articles.

Table 5. Main mode use before park-and-ride facility upgrade (n=400)

	New P&R users									Train (P&R users)	Total
	Car driver	Car passenger	Walk	Bicycle	Bus	Minibus-taxi	Train (non P&R user)	Other	Sub-total		
Brackenfell	15	4	0	0	1	2	3	2	**27**	201	**228**
%	*7*	*2*	*0*	*0*	*0*	*1*	*1*	*1*	***12***	*88*	*100*
Kraaifontein	3	0	0	0	0	0	0	0	**3**	19	**22**
%	*14*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***14***	*86*	*100*
Kuilsrivier	7	0	0	0	0	2	4	0	**13**	137	**150**
%	*5*	*0*	*0*	*0*	*0*	*1*	*3*	*0*	***9***	*91*	*100*
All stations	**25**	**4**	**0**	**0**	**1**	**4**	**7**	**2**	**43**	**357**	**400**
%	*6*	*1*	*0*	*0*	*0*	*1*	*2*	*1*	***11***	*89*	*100*

Table 6. Aspects of new user's daily trips that changed since using park-and-ride facility (N = 43)

	% of respondents		
	Earlier, shorter, less	Later, longer, more	No change
Departure time from home in the morning	*35*	*47*	*19*
Arrival time at home after work	*65*	*12*	*23*
Time spend travelling	*72*	*7*	*21*
Cost of travelling	*86*	*7*	*7*
Amount of other trip made during the workday	*51*	*14*	*35*
Non-response	*0*	*0*	*0*

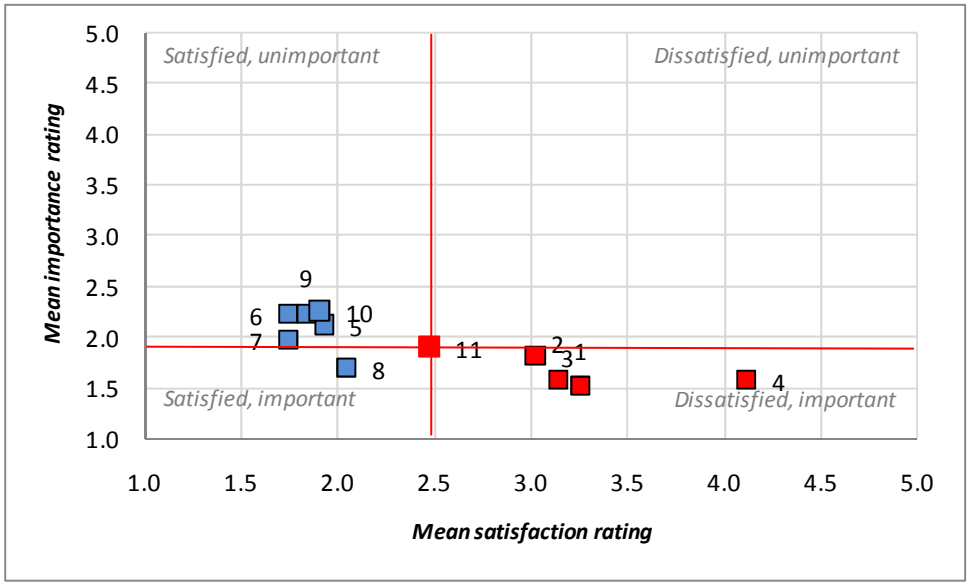
A section in the questionnaire asked for satisfaction ratings (from 'strongly agree', 'agree', 'neutral/do not knows', 'disagree' to 'strongly disagree') in relation to a list of 11 statements regarding service attributes. Following satisfaction rating, respondents were asked to indicate the importance they attached to the service attribute (from 'very unimportant',' unimportant', 'neutral/do not know', 'important' to 'very important').

This technique is explained in Behrens and Schalekamp (2011) as a conventional 'importance-performance analysis' approach to analyse satisfaction and importance data, also referred to as the 'quadrant model' presented in a market research paper by Martilla and James (1977). The technique plots satisfaction and importance rating means for

different service attributes in four quadrants. For Martilla and James these quadrants were labelled 'possible overkill', 'low priority', 'keep up the good work', and 'concentrate here'. Alternatively Behrens and Schalekamp (2011) reports that Bacon (2003) identifies two alternative approaches that have been applied to quadrant delimitation: 'scale-centred', and 'data-centred'. The former plots quadrants on the basis of the midway point on the rating scale (i.e. three in a five-point Likert scale). The latter plots quadrants on the basis of a data centred (i.e. a plot of the mean of all satisfaction ratings against the mean of all importance ratings). The 'concentrate here' quadrant clusters attributes rated as both highest in importance and most dissatisfactory. This data analysis technique enabled an identification of those attributes of a product or service that are either most in need of improvement, or conversely candidates for possible cost-saving measures without leading to significant detriment to overall service quality.

This analysis indicates that new users are mostly concerned for the safety of themselves and their property. The new users were mostly dissatisfied with the fact that their vehicles are unprotected from the weather. Secondly that there are not enough security personnel at the park-and-ride facility and that they are not friendly and helpful. Fourthly the security personnel are not there early in the morning when users start using the facilities and at night when the users return (see figure 10).

Figure 10. Mean satisfaction vs. importance rating for new users (n = 43)



1 There are enough security personnel
2 The security personnel are here early and late enough
3 The security personnel are friendly and helpful
4 My vehicle is protected from the weather
5 The park-and-ride facility is clean
6 Distance between car and station platform is easy to walk
7 The walking surface is in good condition
8 The use of the facility is free
9 The park-and-ride facility looks nice
10 Directions to the facility is clear
11 Data centred

5.3.2 Continuous users

The continuous users were asked how they usually travelled to work before they started using the park-and-ride facilities in 2010 and 57% of them indicated that they commuted to their work by using the railway service. Of these users 30% indicated that they used their own vehicle to travel to their work (see table 7).

Table7. How continuous users used to travel to work before using railway service (n = 357)

	Car driver	Car passenger	Walk	Bicycle	Bus	Minibus-taxi	Train	Other	Non-response	Total
Number of respondents	106	18	2	1	8	15	204	3	0	357
%	*30*	*5*	*1*	*0*	*2*	*4*	*57*	*1*	*0*	*100*

The reasons why the continuous users, who did not always use the train to travel to work, started using the railway service were mainly one associated with cost (see table 8). This entails that by using the park-and-ride facility and through that the rail service that travel cost is cut substantially and was deemed by the user to be cheaper than commuting with own vehicle. Other reasons were that they starting using these facilities because of bad traffic congestion, their commute now is faster than with a car and that the rail service is more convenient than using the bus.

Table8. Why continuous users started using the railway service (n = 53)

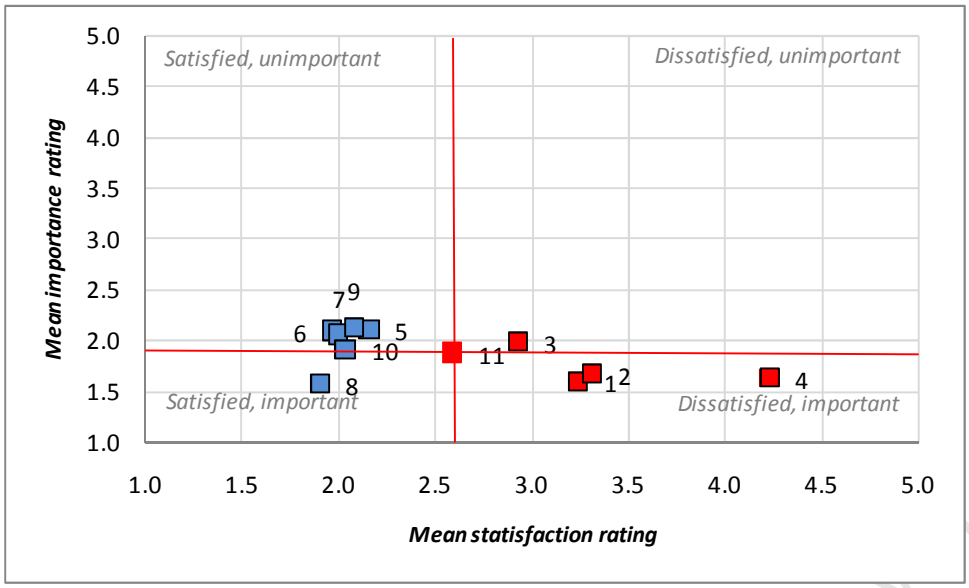
	Saved travel cost	Traffic congestion	Train more convenient than bus	Started new job	Non-response	Total
Number of respondents	103	24	20	6	0	153
%	*67*	*16*	*13*	*4*	*0*	*100*

When the respondents were asked if there was any change in their personal life style that changed that led to them using the park-and-ride facility, 71% indicated no were as the other 19% indicated that it was a direct decision from them taking a new job and 10% because they needed to save money.

The respondents indicated that 89% of them mostly use the facility an average of five times a week which does not coincide with the vehicle registration number analysis. Ninety-eight percent of the respondents indicated that they will keep using the park-and-ride facilities in the future. The respondents also indicated that if there was a bus service between the park-and-ride facility at Brackenfell and Kraaifontein railway stations and the city centre (in both directions), that 81% of them would rather use the train than the bus.

It can be seen that continuous users as with the new user are also dissatisfied with the security aspect of the park-and-ride facilities and deem it to be most important. The continuous users also indicate that they are satisfied with the free usage of the facilities and that it is important for them (see figure 11).

Figure 11. Mean satisfaction vs. importance rating for continuous users (n = 357)



1 There are enough security personnel
2 The security personnel are here early and late enough
3 The security personnel are friendly and helpful
4 My vehicle is protected from the weather
5 The park-and-ride facility is clean
6 Distance between car and station platform is easy to walk
7 The walking surface is in good condition
8 The use of the facility is free
9 The park-and-ride facility looks nice
10 Directions to the facility is clear
11 Data centred

5.3.3 Park-and-ride catchment areas

Figure 12 shows the expected shape of the catchment areas of the three affected park-and-ride facilities. These catchment areas show that 50% of users are expected to come from a radius of 4 to 8km around the park-and-ride facility and another 35% of users from a parabola that extends 16km upstream from the lot with a long cord measuring 16 to 19km

Figure 13 shows the actual shape of the park-and-ride catchment areas that resulted from the user survey data collected in this study. It can be seen that the dimensions of the catchment area differs from the shape found in other park-and-ride studies. In the affected rail stations 90% of users come from an area with a radius of 4 km from the park-and-ride facility. The other 10% come from neighbouring suburbs mostly in a spherical form.

Figure 12. Expected shape of park-and-ride catchment areas

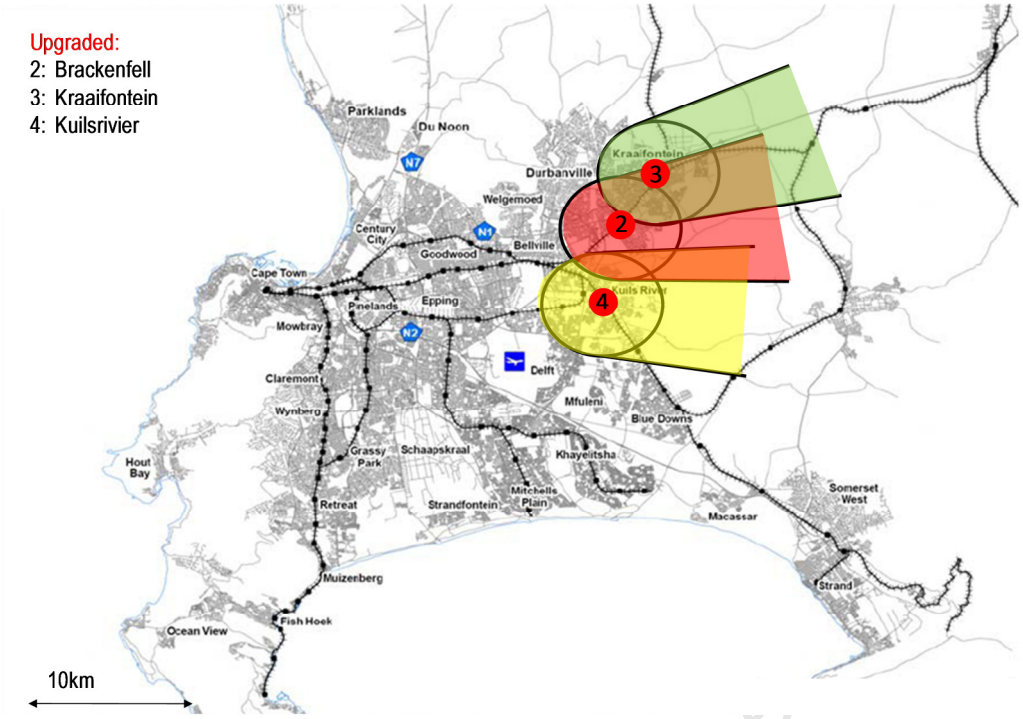
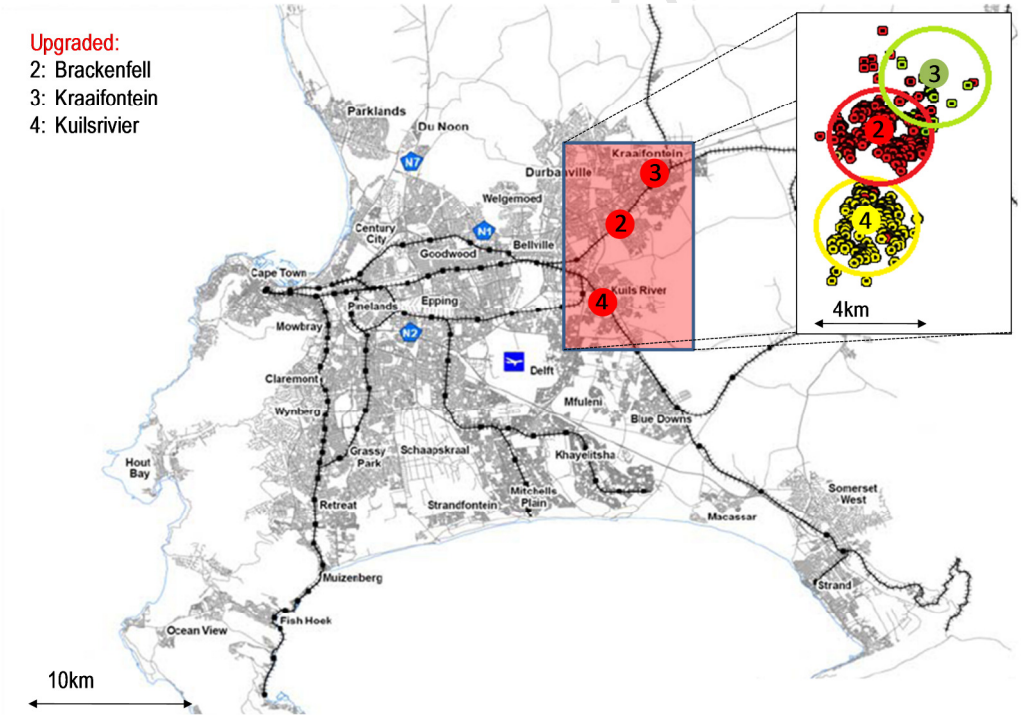


Figure 13. Actual shape of park-and-ride catchment areas (n = 400)



Brackenfell n=228 Kraaifontein n=22
Kuilsrivier n=150

5.4 Non-user intercept survey

Non-users were selected to match as closely as possible the users of the park-and ride facilities. All non-users came from the same demographic area as the users of the park-and-ride facilities and were also able to use these facilities as they work outside of the suburban area in the direction in which the rail service serviced by the park-and-ride facilities travels. Table 9 shows that the majority of non-users were white and coloured with an almost even distribution between male and females respondents. These non-users are mainly from the age group of 26 to 50 years with the majority aging between 36 and 40 years. These non-users have mainly an occupation in the field of sales, security, education and clerical/ administrative profession. The respondents indicated that 35% of them live in a household of three to four members.

Table 9. Park-and-ride non-users by gender and race (n = 400)

	Black	Coloured	Indian	White	Other	Non-Response	Total
Male	52	91	1	85	0	0	229
%	*23*	*40*	*0*	*37*	*0*	*0*	*100*
Female	20	63	1	86	1	0	171
%	*12*	*37*	*1*	*50*	*1*	*0*	*100*
Non-response	0	0	0	0	0	0	0
%	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total	72	154	2	171	1	0	400
%	*18*	*39*	*1*	*43*	*0*	*0*	*100*

The survey further reports that 90% of the non-users indicated that they own a car or have access to a company car. These non-users have access to an average of one vehicle that was indicated by 64% of car users, while 34%, two percent and one percent of non-users indicated that they have access to two, three and four vehicles respectively. The private car was indicated to be the main transport mode of non-users with a share of 74%. It is also apparent that the second most used transport mode is the train service by seven percent of non-users (see table 10).

Table 10 Main transport mode of non-users (n=224)

	Private car	Motorcycle	Bicycle	Bus	Minibus-taxi	Train	Other	Non-response	Total
Number of respondents	297	11	2	1	4	28	57	0	400
%	*74*	*3*	*1*	*0*	*1*	*7*	*14*	*0*	*100*

When the non-user respondents were asked if they are aware of the new upgraded park-and-ride facilities at Brackenfell or Kraaifontein railway station, 56% of them indicated that they are aware of these facilities where the other 44% of non-users have never heard of these facilities. The users that indicated that they know of these facilities said that they became aware of it through the signage outside the station and mainly heard of it from family and friends (see table 11).

Table 11 How non-users became aware of park-and-ride facilities (n=224)

	Inquiry to the City of Cape Town	Road signage outside of station	Newspaper	From family and friends	Radio	Other	Non-response	Other
Number of respondents	2	111	29	58	8	16	0	224
%	*1*	*50*	*13*	*26*	*4*	*7*	*0*	*100*

These respondents then indicated that they do not use the facility firstly because the trains are overcrowded which is represented by 50% of the sample size and secondly that they perceive the railway service not to be safe and that their current transport provides more flexibility (see table 12).

Table 12. Park-and-ride non-users reasons for not using park-and-ride facilities and railway service (n = 224)

	Trains are overcrowded	Trains are overcrowded	Afraid car might be stolen	Trains have slower journey times	Current transport is cheaper	Private transport provides more flexibility	Do not know where to get information on the train service	Was not aware that there are secure Park-and-Ride facilities	Other	Non-response	Total
Number of respondents	112	29	28	2	10	16	1	4	22	0	224
%	*50*	*13*	*13*	*1*	*5*	*7*	*0*	*2*	*10*	*0*	*100*

Of the respondents that indicated that they were not aware of the new upgraded park-and-ride facilities at Brackenfell and Kraaifontein railway station, the respondents indicated that only 47% of them would be interested in using the park-and-ride facilities.

Of the respondents that indicated that they were not aware of the new upgraded park-and-ride facilities at Brackenfell and Kraaifontein railway station, they said the main reason for this was that the trains are overcrowded, unsafe and that they are afraid their car might get stolen (see table 13).

Table 13. Park-and-ride non-users reasons why they would not be interested in using park-and-ride facilities and railway service (n = 93)

	Trains are overcrowded	Trains are not safe	Afraid car might be stolen	Trains have slower journey times	Current transport is cheaper	Private transport provides more flexibility	Do not know where to get information on the train service	Other	Non-response	Total
Number of respondents	33	21	17	0	3	8	2	9	0	93
%	*36*	*23*	*18*	*0*	*3*	*9*	*2*	*10*	*0*	*100*

The non-users also indicated that if there was a bus service between the park-and-ride facility at Brackenfell and Kraaifontein railway stations and the city centre (in both directions), that 74% of them would rather use the train than the bus.

5.5 Summary and conclusion

In summary the vehicle number plate data revealed dissimilar before and after impacts across the affected stations. Brackenfell station experienced an increase of 13% in the after period compared to the before period, which, when compared to the mean 14% increase observed across the three control stations, suggests that the park-and-ride upgrade and had little or no impact. Kraaifontein station experienced an increase of 27% in the after period, which, when compared to the control stations, suggests that an increase of around 13% may be attributed to the park-and-ride upgrade. Kuilsrivier station experienced an increase of 44% in the after period, which, when compared to the control stations, suggests that an increase of around 30% may be attributed to the park-and-ride upgrade and expansion. The data suggest that with a weighted mean before vs. after increase of 29% at the affected stations combined, compared with a 14% increase at the control stations, the park-and-ride improvements could have resulted in a 15% increase in users.

The tracing of individual vehicles in the number plate data over time revealed a high rate of intra-personal variability in behaviour patterns. It was found that from week to week there are first-time users ('new users'), continuing users from the previous week ('repeating users'), and users who had stopped using the facility in the previous week(s) but had returned in the current week ('returning users'). This variation indicates that a phenomenon known as 'churn' – observed in the composition of traffic streams and public transport passenger flows is also present in park-and-ride utilisation. 'Churn' is observable in both the affected and control stations and cannot be regarded as a direct impact of the park-and-ride upgrades. No statistical difference was found in the magnitude of this phenomenon across the affected and control stations. The data also revealed no significant differences in the number of times individuals used the park-and-ride facilities per week in the before, construction and after periods.

Data analysis indicated that 89% of users were park-and-ride users before the upgrades were completed (i.e. before 1 February 2010), and thus only 11% of the users were new users (see table 5). Of this 11% (or 43) new users, 67% were previously car users (including both car drivers and passengers),16% were train users who did not use a park-and-ride facility, nine percent were minibus-taxi users, and one percent were bus users, which indicates that the park-and-ride improvements may have had a small but discernable effect on mode choice. This proportion of new users is inconsistent with the parking count data, which would suggest that new users should be in the region of 22% of the after user group. A possible cause of this discrepancy might be more frequent weekly use by continuing users

in the after period, and thus higher aggregate utilisation in this period without a proportionate increase in new users, but this was not readily apparent in the vehicle tracing analysis.

With regard to new and continuing user satisfaction with the upgraded park-and-ride facilities, 82% were dissatisfied with the fact that their vehicles were unprotected from the weather, 48% were dissatisfied with the number of security personnel, 43% were dissatisfied with the duration of the security service provided which did not cover early arrivals and late departures, and 24% were dissatisfied with the quality of service provided by security guards. Ninety-eight percent of the respondents indicated that they will keep using the park-and-ride facilities in the future.

The reasons cited by new users for why they started using the park-and-ride facilities related to reducing travel costs (55%), changing jobs (28%), and moving house (seven percent). With regard to changes in travel patterns, 47% of new users started leaving home later in the morning to commute to work, 65% arrived home earlier from work, 72% experienced shorter travel times, and 86% indicated that their cost of travelling had decreased. With regard to how they became aware of the park-and-ride facility, 42% became aware through family and friends, 33% saw the new road signage outside the railway station, and 14% had seen newspaper articles.

CHAPTER 6

DISCUSSION AND IMPLICATIONS OF RESEARCH RESULTS

6.1 Introduction

The previous chapters of this dissertation have reviewed park-and-ride practices elsewhere, described the rail-based park-and-ride strategy in Cape Town, and discussed the research methods through which data were collected and analysed. Chapter 5then presented the main findings of the study in terms of the three data collection sources. These are vehicle counts and number plate recordings, user intercept surveys and lastly non-user intercept surveys.

The purpose of this chapter is to discuss the research findings as set out in Chapter 5,to comment on the implications that this information holds for the relevant transport planning practices and how future impact assessment should be carried out in the Cape Town context.

This chapter starts by discussing findings from vehicle counts and number plate recordings in terms of the utilisation of the affected and control park-and-ride facilities; variation in lot composition and individual utilisation patterns; and switching between the park-and-ride facilities. It continues by discussing findings from the user intercept survey in terms of new users and continuous users to the affected park-and-ride facilities as well as the park-and-ride facilities catchment areas. This chapter concludes by discussing findings from the non-user intercept survey.

6.2 Vehicle counts and number plate recording

6.2.1 Park-and-ride facility utilisation

Looking at the utilisation of the park-and-ride facilities, at first glance the analysis shows that usage of the park-and-ride facilities is at its highest at the beginning of the week and declines by the end of the week. This might be because that on Friday's commuters may be more inclined to travel with private car as they might leave work earlier. The average frequency of travel time of the railway service during the period 08h00 – 16h00 is longer than during peak hours and users might not be prepared to wait for the railway service at the end of their work day on Fridays and thus will decide to rather drive into work by the end of the week in order to spare the discomfort of waiting for the railway service.

What is also apparent is that during special events such as the Metrorail strike that started on 17 August 2009, the usage of these facilities was also affected. The analysis showed a major decline in usage at the park-and-ride facilities which would entail the users driving to work with their own vehicle or making use of alternative transport such as the bus service or the use of a minibus-taxi. The analysis showed that the effect of such a strike is not permanent and usage increased as soon as the Metrorail strike ended the next week.

During further analysis of the utilisation charts it can be seen that the utilisation of park-and-ride facilities varies every week. There is no distinct pattern of usage which indicates that the usage of such facilities depends on external variables such as school holidays, public

holidays, employee strikes, fuel price increases and decreases and even the weather. This finding holds implications for the transport field in that it is apparent that when determining the utilisation rate of a parking facility the use of cross-sectional surveys is problematic and the researcher should rather assess the utilisation rate using a longitudinal survey. The problem exists that if the researcher uses a cross-sectional survey to determine the utilisation rate of park-and-ride facilities, there may be a survey in a week with an above normal utilisation rate or in a week of low utilisation, which will give a result that is inaccurate. For example if this dissertation only collected data during the weeks of 18 January to 25 January the data would have shown an utilisation of around 120%. In contrast to this if data was collected in the weeks of 1 January to 7 January the data would have shown a utilisation of round 40%.Thus although this might be a time consuming and expensive undertaking, data must be collected over a long consecutive period and events that occurred during the data collection timeframe be assessed to determine the actual utilisation of these facilities.

The following discussion will explain the utilisation rate at Brackenfell's park-and-ride facility (see figure 6) which will show why the utilisation is so variable and the need for longitudinal analysis:

The two months before construction started at Brackenfell, Kraaifontein and Kuilsrivier railway station's park-and-ride facilities saw the introduction of the 'Commuter Safety Programme' by the SAPS. It is from this date that vehicle registration numbers were recorded at this facility. This event was shortly followed by the school holidays and a fuel price increase. The school holidays might explain the decrease in usage in the second week of the before period. The last four weeks in the charts that show the utilisation of the park-and-ride facilities before construction saw the beginning of the second school semester which might again explain the increase in usage of this facility. The fuel price decrease at the beginning of August could have encouraged users to rather drive into work because they now regard their travel cost to be less and with the added comfort of driving with their own vehicle to work.

This event together with the start of the construction period and the Metrorail strike could explain the poor utilisation at the beginning of the construction period. A fuel price increase at the beginning of the second week of the construction period might explain the increase in usage again and the start of the school holiday in September might then again explain the sudden increase in usage. October again saw a fuel price decrease and in turn the utilisation of the facility decreased together with construction being undertaken at the facility. In December of 2009 there was again a fuel price increase which was followed shortly by the summer holidays which saw the underutilisation of this facility during this period. It can be seen that on the 16th of December there was a major drop in usage in the middle of the week that could be explained by the public holiday: 'Day of Reconciliation'. In the end of January the school semester for 2010 started with a decrease in the fuel price which explains the underutilisation during this month.

The period after construction is when the marketing of the upgraded park-and-ride facilities started and when the new facility and parking bays was ready for use. March saw a fuel price increase with the start of the first school holiday for 2010 which again explains the sudden decrease in usage. What is apparent from the last few weeks in the after period is that the three week Metrorail strike had a definitive impact on the utilisation of the park-and-ride facilities with the start of the FIFA soccer world cup.

It came to the researcher's attention that when determining the utilisation rate of park-and-ride facilities parking spaces may have user turnover in which a vacated space is immediately occupied by another user. This was observed at a site visit during the project timeframe which shows the necessity of vehicle registration number plate recordings in

determining actual parking utilisation, rather than simple vehicle counts. It was also observed during this site visit that 94% of users for the day arrive during the timeframe of 06h00 to 08h30 and that 35% leave the park-and-ride facility between 14:00 and 17:00 with 59% of user leaving the facility between 17:00 and 19:00.

6.2.2 Switching between park-and-ride facilities

The analysis showed that before the upgrades of the park-and-ride facilities, some of the users of a specific park-and-ride facility made use of a different park-and-ride facility located near the vicinity of the specific park-and-ride facility. Mostly these facilities are located closer than 6km from one another.

As soon as the upgrades started a major increase in vehicles switching between stations could be seen whereby users started using park-and-ride facilities that were located closest to the facility that they normally use. This could be seen especially at the park-and-ride facilities which received the facility upgrades whereby the variation at these facilities and those closest to them increased tremendously. This might be explained by the fact that construction took place at the park-and-ride facilities and that through this the users were obstructed from using the facility or worried that their vehicle might get damaged.

After upgrades of the park-and-ride facilities it can be seen that variation between stations became more stable with fewer users now using other station's park-and-ride facilities. This could also be observed at the park-and-ride facilities which did not receive construction upgrades. This might be due to users who used to switch between park-and-ride facilities becoming more loyal to the most convenient park-and-ride facility.

6.2.3 Variation in lot composition and individual utilisation patterns

Focusing on the breakdown of park-and-ride users, it is apparent (see figures 8 and 9) that every week there are new users to the park-and-ride facilities who use it for the first time, continuous users who return from the previous week and users who did not return to these facilities the previous week. In some instances the usage of the park-and-ride facilities increase and in some instances decreased with this variation of users. This variation indicates that the phenomenon known as churn (see Chatterjee (2001) is present at park-and-ride facilities serving a railway station. According to Chatterjee, in terms of travel behaviour, an asymmetric pattern of churn can be said to be gross changes in the travel behaviour of individuals that not being equal and opposite result in a net change in aggregate travel behaviour. Thus it suggests that the gross changes in travel behaviour do not cancel each other out and a net increase in usage can be seen. Through this phenomenon being present at the park-and-ride facilities it can be said that the utilisation of the park-and-ride facilities might increase slowly, although the data does not indicate it in a short monitoring timeframe.

This phenomenon can be seen across all park-and-ride facilities in the dissertation's case study and cannot be said to be a direct impact of the park-and-ride upgrades. Also no statistical difference can be seen in the magnitude of this phenomenon between the stations whereby the facilities which did receive upgrades did not generate more new users to the system.

6.3 User intercept survey

The analysis also showed that park-and-ride users mostly drive to the facility with another user. This is a positive finding from the perspective of reducing per capita vehicle kilometres travelled.

Reflecting on the representation of ethnic groups in the sample size, the small representation of black users can be explained due to the fact that the park-and-ride facilities were the surveys took place are located in mainly in white and coloured residential areas. The reason for the small representation of females might be because they mostly decide not to use the railway service because of security issues as found in other park-and-ride studies.

6.3.1 New users

During the two week data collection period only 11% of respondents indicated that they were new users to the facility after upgrades were completed. Whether these users started using the park-and-ride facilities as a direct result of upgrades could not be said with certainty as new users were observed every week. In the intercept survey, many new users to the park-and-ride facilities indicated that they actually used the train before using the park-and-ride facilities to travel to their work. Here the new users used the railway service but not the park-and-ride facility and were dropped off at the station in the morning and picked up in the evening. This shows a shift from kiss-and-ride users to park-and-ride users due to the upgrade of the park-and-ride facilities. This might explain why when looking at the quarterly ridership counts that the construction or upgrade of park-and-ride facilities will not always lead to an increase in the public transport mode (rail in this case) for which it was intended.

Analysis of the intercept survey data indicated that park-and-ride users are mostly concerned for the safety of themselves and their property. The users were mostly dissatisfied with the fact that their vehicles are unprotected from the weather. They were also dissatisfied that there are not enough security personnel at the park-and-ride facilities and that they are not sufficiently friendly and helpful. They indicated that the security personnel are not present early in the morning when users start using the facilities, and at night when the users return after work. This is quite a complex issue as property at the railway stations is owned by PRASA, Transnet and the City of Cape Town. Security personnel on one property do not have any jurisdiction on the other property and are not obligated to move through these properties to make sure all railway users and their property is safe. Although the SAPS are obligated to monitor the safety of property and passengers at the facility, this does not always happen. However conversations with a SAPS representative (Ms Caroles – CSP coordinator) indicated that the programme by the SAPS of providing visual enforcement is an effective initiative as it had resulted in a decrease in car theft. But as the security personnel are mostly women with little means of actually protecting the vehicles or users as they leave or return to their vehicles in the case of a robbery, this is worrisome. Providing 24 hour security or rather from early in the morning till late at night will definitely reassure the users that they and their vehicles are safe and could lead to a higher utilisation rate. Reflecting back on the importance-satisfaction analysis, security is a service attribute that must get a lot of attention as to attract and keep new users.

6.3.2 Continuous users

What is apparent from the continuous users is that more than half of them already used the railway service prior to using the park-and-ride facilities. This again shows that the park-and-ride facilities can convert kiss-and-ride users to park-and-ride users.

Analysis of the intercept survey data indicated that park-and-ride users are mostly concerned for the safety of themselves and their property. The users were mostly dissatisfied with the fact that their vehicles are unprotected from the weather, that there are not enough security personnel at the park-and-ride facility, that they are not friendly and helpful, and that the security personnel are not there early in the morning when users start using the facilities and at night when the users return.

When analysing the park-and-ride catchment area maps it can be seen that although these areas are similar to what is observed from other park-and-ride studies from around the world, that there is a difference in terms of where some users come from. This could be because users in the City of Cape Town are willing to drive a longer distance to reach a certain park-and-ride facility that they deem to be attractive. This will entail them passing some park-and-ride facilities on their way to the specific park-and-ride facility to use it for the day. This might lead to further traffic congestion in the vicinity in the surrounding neighbourhoods. This shows the importance of selecting the correct park-and-ride facilities to be upgraded so as to decrease user travel time and distance travelled to use public transport.

6.4 Non-user intercept survey

When examining the data on non-users of park-and-ride facilities it can be seen that they have mostly the same socio-demographic characteristics as the park-and-ride users. This may be because the non-user intercept surveys took place within the park-and-ride catchment areas. What could also be seen is that eight percent of these non-users already use public transportation of which seven percent use the railway service. It can be said that these seven percent have a high probability of becoming park-and-ride users due to the fact that it seems that park-and-ride facilities changes kiss-and-ride users to park-and-ride users.

The intercept survey further showed that non-users are mainly concerned with issues about the railway service and indicated that this was the reason why they do not or will not use park-and-ride facilities. This shows that if an increase in park-and-ride facilities isto be achieved the transport system as a whole must be marketed and services upgraded.

It can be said that the marketing of these facilities did make non-users aware of these facilities but maybe not on a scale that would be wanted. During the FIFA World Cup the marketing of these facilities resulted in a higher than normal utilisation on match days which indicates that the marketing was effective but still lacked the ability to convert private transport users to rather use the park-and-ride facility and railway service for work trips. The analysis showed that only 38% of users were made aware of the park-and-ride facilities through the City of Cape Town's marketing strategy.

6.5 Summary and conclusion

The utilisation of the park-and-ride facilities showed that usage of the facilities is at its highest at the beginning of the week and declines by the end of the week. It is recommended that when determining the utilisation of these facilities parking count are only undertaken during mid-week, i.e. Tuesdays till Thursdays, as this is when usage is at its most stable.

It is suggested that when determining the utilisation rate of a parking facility the use of cross-sectional surveys is inappropriate. The problem exists that if the researcher uses a cross-sectional survey to determine the utilisation rate of park-and-ride facilities, there may be a survey in a week with an above normal utilisation rate or in a week of low utilisation, which will give a result that is inaccurate.

It was determined that parking spaces at the park-and-ride facilities had user turnover. This raises the necessity of using vehicle registration number plate recordings in determining actual parking utilisation.

Focusing on the breakdown of park-and-ride users, it is apparent that every week there are new users to the park-and-ride facilities who use it for the first time, continuous users who

return from the previous week and users who did not return to these facilities the previous week. In some instances the usage of the park-and-ride facilities increased and in other instances decreased with this variation of users. This variation indicates that the phenomenon known as churn is present at park-and-ride facilities serving a railway station.

Analysis of the intercept survey data indicated that park-and-ride users are mostly concerned for the safety of themselves and their property. The users were mostly dissatisfied with the fact that their vehicles are unprotected from the weather, that there are not enough security personnel, and that the security personnel are not there early in the morning and at night. Providing security from early in the morning till late at night will reassure the users that they and their vehicles are safe and could lead to a higher utilisation rate.

CHAPTER 7

CONCLUSION

The main aims of the research were to establish whether the utilisation rates of park-and-ride facilities had changed following expansion and upgrade, how the upgraded facilities altered switching users' travel patterns, why and when new users switched to park-and-ride use, and how effectively the upgrades were marketed. With regard to utilisation rates, it was found that there was an increase in two of the three affected rail stations that might be attributed to facility expansion or upgrade. With regard to altered travel patterns, it was found that most new users reported positive impacts on their travel patterns with respect to travel time and cost. With regard to reasons for switching to park-and-ride use, and with the caveat that the sample of car use switchers in the survey is small, it was found that a desire to reduce travel costs was the main reason for switching from private to public transport commuting, and that switching was often associated with life style change in the form of starting a new job or moving house. With regard to marketing effectiveness, it was found that the City of Cape Town's park-and-ride marketing strategy was fairly effective, but insufficiently persuasive to convert large numbers of car commuters into rail commuters.

The City of Cape Town's park-and-ride strategy might be improved to retain and attract users by providing improved security at the facilities. A common dissatisfaction expressed by respondents in the user survey was unreliable security provision over an insufficiently long duration. The intermittent security provided at the facilities previously, was unrelated to the City's park-and-ride strategy. Further, the uneven impacts revealed in the study indicate that station selection and prioritisation criteria could be improved in future expansion and upgrade. In particular, it is clear that stations with a high- or over-utilisation of parking facilities are likely to yield better results than those with low-utilisation. A limitation in attracting large-scale growth in park-and-ride users from private transport is, however, car user perceptions of the quality of train service. Ideally park-and-ride strategies should be closely linked to innovative strategies to improve train service quality. This was not the case in the contemporaneous Metrorail Business Express service introduction and the park-and-ride strategy formulation (although the Huguenot-Cape Town Business Express service introduced in April 2010 does stop at Kraaifontein and Brackenfell stations).

An important methodological lesson emerging from the research is the potentially inaccurate conclusions on TDM impacts that could be drawn from a comparison of repeated before and after cross-section data. An important finding in the research, emerging from the analysis of 12 month longitudinal data, was the significant variation and 'churn' in vehicle parking at the park-and-ride facilities. Arbitrary selection of before and after cross-section data collection dates could have led to highly misleading negative or positive results. Extended longitudinal before and after data collection in TDM assessment enables better understanding of unstable impacts.

It is recommended that future research be done to study the long term effects on not only rail-based park-and-ride facilities, but also bus-based park-and-ride facilities which are the most commonly used facilities around the world. This information, if available in South Africa, is not well documented and provides considerable scope for future research by academics. The reasons why car commuters reappraise their travel behaviour to shift to public transport is still vague, but is important information for the success of strategies aimed at mode switching. The utilisation of park-and-ride facilities that serve as transport interchanges has been shown to be highly variable and possibly incorrectly documented by previous studies.

The use of kiss-and-ride facilities is also not well documented and methods to assess their use are underdeveloped.

The effect that the park-and-ride facilities have on traffic conditions in the neighbourhoods surrounding the facilities is still unknown and needs investigation. Future studies need to be carried out on the transport system as a whole that includes a commuter's journey to the park-and-ride facility and from that on the public transport system to where the commuter works. This is an integrated system that must work together in unison to see the effective shift of car commuters to public transport users.

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ANNEXURE A: User intercept questionnaire

Park-and-Ride facilities: User intercept survey

Q/I number | | | | | |

Date of interview | D | D | M | M | Y | Y | Y | Y |

Instructions to interviewer

Identify and approach people who enter the parking area from the railway station. Introduce yourself, and explain the following:

This survey is part of a Master dissertation research project at the University of Cape Town, which will collect information on the impact Park-and-Ride facilities at railway stations have on commuter travel behaviour. We would like to ask you some questions which should take around 10 minutes. All the information collected will be treated confidentially. May I proceed?

Filter questions:

a. Did you use the railway service today? (If **No**, close interview)
b. Did you use a vehicle parked at the Park-and-Ride facility at Brackenfell/Kraaifontein railway station today? (If **No**, close interview)

1. INTERVIEW (*to be completed by interviewer before or after the interview*)

1.1 Rail station

□ *Brackenfell* □ *Kraaifontein*

1.2 Gender of respondent?

□ *Male* □ *Female*

1.3 Race of respondent?

□ *Black* □ *Coloured* □ *Indian* □ *White*

□ *Other (specify)* .....

INTERVIEW STARTS HERE

2. RESPONDENT

2.1 Where do you live?

□ *Suburb* ..... □ *Street* .....

2.2 How would you best describe your occupation?

□ *Civil servant (e.g, government official)*
□ *Clerical/administrative employee*
□ *Customer service (e.g. tourism)*
□ *Marketing/ advertising*
□ *Education*
□ *Entertainment (e.g. presenter)*
□ *Factory worker*
□ *Security (e.g. policemen)*
□ *Tradesman (e.g. plumber)*
□ *IT related*
□ *Finance*
□ *Medical professional*
□ *Human Resource*
□ *Professional*
□ *Retail (e.g. store manager)*
□ *Sales (e.g. agent)*
□ *Transport (e.g. driver)*

□ *Other (specify* .....

2.3 How many people are in your household? .....

2.4 What type of transport do you usually use to travel to work (*if more than one, choose the one which covers the longest distance*)?

□ *Car driver* □ *Car passenger* □ *Walk* □ *Bicycle*
□ *Bus* □ *Taxi* □ *Train*

□ *Other (specify)* .....

2.5 Does your household own a car or have the use of a company car?

□ *Yes, how many* ..... □ *No*

2.6 How old are you? .....

3. USE OF THE PARK-AND-RIDE FACILITY

3.1 Are you the driver or a passenger of the parked vehicle?

□ *Driver* □ *Passenger*

3.2 How many people drove in with you this morning who also used the train service?

……

3.3 For what main purpose are you using the train service today?

□ *To go to work* □ *To carry out personal business*
□ *To go shopping* □ *To go to an educational institution*

□ *Other (specify)* ……

3.4 At which railway station did you disembark?

……

3.5 When did you start using this Park-and-Ride facility?

Year …… □ *cannot remember*

Month …… □ *cannot remember*

IF AFTER **1 FEBRUARY 2010**, GO TO QUESTION 3.6

IF BEFORE **1 FEBRUARY 2010**, GO TO QUESTION 3.11

NEW USERS

3.6 How did you usually travel to work before 1 February 2010?

□ *Car driver* □ *Car passenger* □ *Walk* □ *Bicycle*
□ *Bus* □ *Taxi* □ *Train*

□ *Other (specify)*……

3.7 Why did you start using this Park-and-Ride facility?

……

……

……

……

3.8 Was there any change in your life style (e.g. moving house, new job) that made you change your way of travelling to work?

□ *No* □ *Yes, what?*

……

……

……

……

3.9 Did the following aspects of your usual trip to and from work change after you started using the Park-and-Ride facility?

a.	*Departure time from home in the morning*	□ *Yes*	□ *No*
b.	*Arrival time at home after work*	□ *Yes*	□ *No*
c.	*Time spend travelling*	□ *Yes*	□ *No*
d.	*Cost of travelling*	□ *Yes*	□ *No*
e.	*Amount of other trips made during the workday*	□ *Yes*	□ *No*
f.	*Other (specify)* ……	□ *Yes*	

3.10 How did you become aware of the Park-and-Ride facility?

□ *Inquiry to the City of Cape Town* □ *From family and friends*
□ *Road signage outside station* □ *Radio*
□ *Newspaper*

□ *Other (specify* ……

GO TO QUESTION 3.14

CONTINUING USERS

3.11 How did you usually travel to work before using the train?

□ *Car driver* □ *Car passenger* □ *Walk* □ *Bicycle*
□ *Bus* □ *Taxi* □ *Always used train (GO TO QUESTION 3.14)*

□ *Other (specify)*.....

3.12 Why did you start using the train?

.....

.....

3.13 Was there any change in your life style (e.g. moving house, new job) that made you start using the train?

□ *No* □ *Yes, what?*

.....

.....

.....

3.14 How many times a week do you use this Park-and-Ride facility? .....

3.15 Do you use any other Park-and-Ride facility?

□ *Yes, which?* ..... □ *No*

how many times a week do you use this facility .....

3.16 Will you keep using the Park-and-Ride facility and the railway service over the next year?

□ *Yes* □ *No, why not?* .....

.....

3.17 If there was bus service between the Park-and-Ride facility and the city centre (in both directions), would you rather use that than the train service?

□ *Yes* □ *No*

3.18 I will now read out a statement describing the Park-and-Ride facility. Please indicate first whether you 'strongly agree', 'agree', 'disagree' or 'strongly disagree' with the statement. You could also indicate that you do not have an opinion on the statement. After this, please indicate whether you think this feature of the Park-and-Ride facility is 'very unimportant',' unimportant', 'important' or 'very important'. Here too you could indicate that you do not have an opinion.

	Satisfaction					Importance				
	Strongly Agree	Agree	Neutral / Don't know	Disagree	Strongly Disagree	Very Unimportant	Fairly unimportant	Neutral/ Don't know	Fairly Important	Very Important
There are enough security personnel.										
The security personnel are here early enough and late enough.										
The security personnel are friendly and helpful.										
My vehicle is protected from the weather.										
The Park-and-Ride facility is clean.										
The distance between my car and the station platform is easy to walk.										
The walkway surface is in good condition .										
The use of the Park-and-Ride facility is free .										
The Park-and-Ride facility looks nice.										
Directions to the Park-and-Ride facility are clear.										

Thank you for your time.

ANNEXURE B: User intercept questionnaire database codes and fields

Station *(Rail station)*
1=Brackenfell
2=Kraaifontein

Gender *(Gender of respondent?)*
1=Male
2=Female

Race *(Race of respondent?)*
1=Black
2=Coloured
3=Indian
4=White
5=Other (specify)

Race other*(Other (specify))*
Data entry indicates the race of the respondent if not specified in database field

Work location *(Where do you work?)*
Data entry indicates the suburb in which the respondent lives

Occupation *(How would you best describe your occupation?)*
1=Civil servant (e.g. government official)
2=Clerical/administrative employee
3=Customer service (e.g. tourism)
4=Marketing/advertising
5=Education
6=Entertainment (e.g. presenter)
7=Factory worker
8=Security (e.g. policemen)
9=Tradesman (e.g. plumber)
10=IT related
11=Finance
12=Medical professional
13=Human resource
14=Professional
15=Retail (e.g. store manager)
16=Sales (e.g. agent)
17=Transport (e.g. driver)
18=Other (specify)

Occupation other *(Other (specify))*
Data entry indicates the occupation of the participant if not specified in database field

Household size*(How many people are in your household?)*
Data entry indicates the number of people in the respondent's household

Travel to work *(What type of transport do you usually use to travel to work (if more than one, note that which covers the longest distance?)*
1=Car driver
2=Car passenger
3=Walk
4=Bicycle
5=Bus
6=Taxi
7=Train
8=Other (specify)

Travel to work other *(Other (specify))*
Data entry indicates the type of transport the respondent uses to travel to work if not specified in database field

Car ownership/access *(Does your household own a car or have the use of a company car?)*
1=Yes
2=No

How many *(If YES, how many?)*
Data entry indicates the number of cars owned or that the respondent has access to

Age *(How old are you?)*
Data entry indicates the age of the respondent

Driver/passenger *(Are you the driver or a passenger of the parked vehicle?)*
1=Driver
2=Passenger

 # people *(How many people drove in with you this morning who also used the train service?)*
Data entry indicates the number of people who drove in with the respondent that

morning and who also used the train service

Main purpose *(For what main purpose are you using the train service today?)*
1=To go to work
2=To go shopping
3=To carry out personal business
4=To go to an educational institution

Main purpose other *(Other (specify))*
Data entry indicates the main purpose for what the respondent uses the train service that day if not specified in database field

Where place *(Where is this place?)*
Data entry indicates where the place is that the respondent is travelling to using the train service

Year *(When did you start using this park-and-ride facility?)*
Data entry indicates the year when the respondent started using the park-and-ride facility

Month *(When did you start using this park-and-ride facility?)*
Data entry indicates the month when the respondent started using the park-and-ride facility

Usually travel work *(How did you usually travel to work before this date?)*
1=Car driver
2=Car passenger
3=Walk
4=Bicycle
5=Bus
6=Taxi
7=Train
8=Other (specify)

Usually travel work other *(Other (specify))*
Data entry indicates the how the respondent usually travel to work before this date if not specified in database field

Why start use P&R *(Why did you start using this park-and-ride facility?)*
Data entry indicates why the respondent started using the park-and-ride facility

Change *(Was there any change in your life style (e.g. moving house, new job) that made you change your way of travelling to work?)*
1=Yes
2=No

What *(Yes, what?)*
Data entry indicates if there was any change in the respondent's life style (e.g. moving house, new job) that made him/her change your way of travelling to work?)

Departure *(Departure time from home in the morning?)*
1=Yes
2=No

Arrival *(Arrival time at home after work?)*
1=Yes
2=No

Time spend *(Time spend travelling?)*
1=Yes
2=No

Cost *(Cost of travelling?)*
1=Yes
2=No

Amount *(Amount of other trip made during the workday?)*
1=Yes
2=No

Other *(Other (specify))*
Data entry indicates any other changes in the respondent's life style if not specified in database field

Aware *(How did you become aware of the park-and-ride facilities?)*
1=Inquiry to the City of Cape Town
2=Road signage outside station
3=Newspaper
4=From family and friends
5=Radio
6=Other (specify)

Aware other *(Other (Specify))*
Data entry indicates how the respondent became aware of park-and-ride facilities if not specified in database field

Usually travel train *(How did you usually travel to work before using the train?)*
1=Car driver
2=Car passenger
3=Walk
4=Bicycle
5=Bus
6=Taxi
7=Train
8=Other (specify)

Usually travel train other *(Other (specify))*
Data entry indicates the how the respondent usually travel to work before this date if not specified in database field

Why start use train *(Why did you start using the train?)*
Data entry indicates why the respondent started using the train

Change2 *(Was there any change in your life style (e.g. moving house, new job) that made you start using the train?)*
1=Yes
2=No

What2 *(Yes, what?)*
Data entry indicates if there was any change in the respondent's life style (e.g. moving house, new job) that made him/her change your way of travelling to work?)

Times a week *(How many times a week do you use this park-and-ride facility?)*
Data entry indicates how many times a week the respondent uses the park-and-ride facility

Use other *(Do you use any other park-and-ride facility?)*
Data entry indicates if the respondent uses any other park-and-ride facilities

Which *(Yes, which?)*
Data entry indicates what park-and-ride facility the participant also uses

Usage other *(how many times a week do you use this facility?)*
Data entry indicates how many times a week the respondent uses the park-and-ride facility

Keep using *(Will you keep using the park-and-ride facility and the railway service over the next year?)*
1=Yes
2=No

Not keep using *(No, why not?).*
Data entry indicates why the respondent will not keep on using the park-and-ride facility

Bus service *(If there was a bus service between the park-and-ride facility at Brackenfell/Kraaifontein railway station and the city centre (in both direction), would you rather use it than the train?)*
1=Yes
2=No

S - enough security *(There are enough security personnel)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I - enough security *(There are enough security personnel)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S - late/early enough *(The security personnel are here early and late enough)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I - late/early enough *(The security personnel are here early and late enough)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant

5=unimportant

S - friendly/helpful *(The security personnel are friendly and helpful)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I - friendly/helpful *(The security personnel are friendly and helpful)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S – protected *(My vehicle is protected from the weather)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I – protected *(My vehicle is protected from the weather)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S – clean*(The park-and-ride facility is clean)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I – clean *(The park-and-ride facility is clean)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S – distance *(The distance between my car and station platform is easy to walk)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I – distance *(The distance between my car and station platform is easy to walk)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S – surface *(The walkway surface is in good condition)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I – surface *(The walkway surface is in good condition)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S - use free *(The use of the park-and-ride facility is free)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I - use free *(The use of the park-and-ride facility is free)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S - facility looks nice *(The park-and-ride facility looks nice)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

I - facility looks nice *(The park-and-ride facility looks nice)*
1=very important

2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

I - directions are clear *(Directions to the park-and-ride facility are clear)*
1=very important
2=fairly important
3=neutral
4=fairly unimportant
5=unimportant

S - directions are clear *(Directions to the park-and-ride facility are clear)*
1=strongly agree
2=agree
3=neutral
4=disagree
5=strongly disagree

ANNEXURE C: Non-user intercept questionnaire

Park-and-Ride facilities: Non-user intercept survey

Q/I number | | | | | |

Date of interview | D | D | M | M | Y | Y | Y | Y |

Instructions to interviewer

Introduce yourself, and explain the following:

This survey is part of a Master dissertation research project at the University of Cape Town, which will collect information on what impact Park-and-Ride facilities at railway stations have on commuter travel behaviour. We would like to ask you some questions which should take no longer than 5 minutes. All the information collected will be confidential. May I proceed?

Filter questions:

a. Do you live in Brackenfell/Kraaifontein or towards Paarl? (If **No**, close interview)
b. Do you work in the city centre or somewhere along the Bellville to Cape Town railway line? (If **Yes**, close interview)
c. Do you make use of the Park-and-Ride facility at Brackenfell/Kraaifontein railway station? (If **Yes**, undertake user survey)

1. INTERVIEW (*to be completed by interviewer before or after the interview*)

1.1 Place name and suburb?

□ *Shoprite centre (Kraaifontein)* □ *Hypermarket centre (Brackenfell)*
□ *Spar centre (Kraaifontein)* □ *Fairbridge mall (Brackenfell)*

□ *Other (specify)*.....

1.2 Gender of respondent?

□ *Male* □ *Female*

1.3 Race of respondent?

□ *Black* □ *Coloured* □ *Indian* □ *White*

□ *Other (specify)*.....

INTERVIEW STARTS HERE

2. RESPONDENT

2.1 Where do you work?

□ *Suburb* .....

2.2 How would you best describe your occupation?

□ *Civil servant (e.g, government official)*
□ *Clerical/administrative employee*
□ *Customer service (e.g. tourism)*
□ *Marketing/ advertising*
□ *Education*
□ *Entertainment (e.g. presenter)*
□ *Factory worker*
□ *Security (e.g. policemen)*
□ *Tradesman (e.g. plumber)*
□ *IT related*
□ *Finance*
□ *Medical professional*
□ *Human Resource*
□ *Professional*
□ *Retail (e.g. store manager)*
□ *Sales (e.g. agent)*
□ *Transport (e.g. driver)*

□ *Other (specify)* .....

2.3 How many people are in your household? .....

2.4 What type of transport do you usually use to travel to work (*if more than one, note that which covers the longest distance*)?

□ *Car driver* □ *Car passenger* □ *Walk* □ *Bicycle*
□ *Bus* □ *Taxi* □ *Train*

□ *Other (specify)* .....

2.5 Does your household own a car or have the use of a company car?

□ *Yes* □ *No*

If **Yes**, how many? .....

2.6 How old are you? .....

3. PARK-AND-RIDE FACILITY

3.1 Are you aware of the new upgraded Park-and-Ride facility at Brackenfell/Kraaifontein railway station?

□ *Yes* □ *No*

IF NO, GO TO 3.4

3.2 How did you become aware of the Park-and-Ride facility?

□ *Inquiry to the City of Cape Town* □ *From family and friends*
□ *Road signage outside station* □ *Radio*
□ *Newspaper*

□ *Other (specify* ……

3.3 Why do you not use the Park-and-Ride facility and the railway service to travel to work? *(Indicate single most important reason)*

□ *Trains are overcrowded*
□ *Trains are not safe*
□ *Afraid car might be stolen*
□ *Trains have slower journey times*
□ *Current transport is cheaper*
□ *Private transport provides more flexibility*
□ *Do not know where to get information on the train service*
□ *Was not aware that there are secure park and ride facilities*

□ *Other (specify)*……

GO TO QUESTION 3.5

3.4 Would you be interested in using the Park-and-Ride facility at Brackenfell/Kraaifontein railway station?

□ *Yes* □ *No*

If **No**, what is the single most important reason for not wanting to use the Park-and-Ride facility?

□ *Trains are overcrowded*
□ *Trains are not safe*
□ *Afraid car might be stolen*
□ *Trains have slower journey times*
□ *Current transport is cheaper*
□ *Private transport provides more flexibility*
□ *Do not know where to get information on the train service*

□ *Other (specify)*……

3.5 If there was Bus Service between the Park-and-Ride facility at Brackenfell/Kraaifontein railway station and the city centre (in both directions), would you rather use it than the train?

□ *Yes* □ *No*

Thank you for your time.

ANNEXURE D: Non-user intercept questionnaire database codes and fields

Place/suburb *(Place name and suburb?)*
1=Shoprite centre (Kraaifontein)
2=Spar centre (Kraaifontein)
3=Hypermarket centre (Brackenfell)
4=Fairbridge mall (Brackenfell)
5=Other (specify)

Place other *(Other (specify))*
Data entry indicates the place name and suburb of additional locations where the survey where undertaken

Gender *(Gender of respondent?)*
1=Male
2=Female

Race *(Race of respondent?)*
1=Black
2=Coloured
3=Indian
4=White
5=Other (specify)

Race other *(Other (specify))*
Data entry indicates the race of the respondent if not specified in database field

Work location *(Where do you work?)*
Data entry indicates the suburb in which the respondent works

Occupation *(How would you best describe your occupation?)*
1=Civil servant (e.g. government official)
2=Clerical/administrative employee
3=Customer service (e.g. tourism)
4=Marketing/advertising
5=Education
6=Entertainment (e.g. presenter)
7=Factory worker
8=Security (e.g. policemen)
9=Tradesman (e.g. plumber)
10=IT related
11=Finance
12=Medical professional
13=Human resource
14=Professional
15=Retail (e.g. store manager)
16=Sales (e.g. agent)
17=Transport (e.g. driver)
18=Other (specify)

Occupation other *(Other (specify))*
Data entry indicates the occupation of the respondent if not specified in database field

Household size *(How many people are in your household?)*
Data entry indicates the number of people in the respondent's household

Travel to work *(What type of transport do you usually use to travel to work (if more than one, note that which covers the longest distance?)*
1=Car driver
2=Car passenger
3=Walk
4=Bicycle
5=Bus
6=Taxi
7=Train
8=Other (specify)

Travel to work other *(Other (specify))*
Data entry indicates the type of transport used by the respondent if not specified in database field

Car ownership/access *(Does your household own a car or have the use of a company car?)*
1=Yes
2=No

How many *(If YES, how many?)*
Data entry indicates the number of cars owned or that the respondent has access to

Age *(How old are you?)*
Data entry indicates the age of the respondent

Aware *(Are you aware of the new upgraded park-and-ride facilities at Brackenfell/Kraaifontein railway station?)*

1=Yes
2=No

Become aware *(How did you become aware of the park-and-ride facilities?)*
1=Inquiry to the City of Cape Town
2=Road signage outside station
3=Newspaper
4=From family and friends
5=Radio
6=Other (specify)

Become aware other *(Other (specify))*
Data entry indicates how the respondent became aware of park-and-ride facilities if not specified in database field

Why not use *(Why do you not use the park-and-ride facilities and the railway service to travel to work? (indicate single most important reason))*
1=Trains are overcrowded
2=Trains are not safe
3=Afraid car might be stolen
4=Trains have slower journey times
5=Current transport is cheaper
6=Private transport provides more flexibility
7=Do not know where to get info on the train service

Interested why not other *(Other (specify))*
Data entry indicates why the respondent do not use the park-and-ride facilities if not specified in database field

Bus service *(If there was a bus service between the park-and-ride facility at Brackenfell/Kraaifontein railway station and the city centre (in both direction), would you rather use it than the train?)*
1=Yes
2=No

8=Was not aware that there are secure park-and-ride facilities
9=Other (specify)

Why not use other *(Other (specify))*
Data entry indicates why the respondent do not use park-and-ride facilities if not specified in database field

Interested *(Would you be interested in using the park-and-ride facility at Brackenfell/Kraaifontein railway station?)*
1=Yes
2=No

Interested why not *(If NO, why not (indicate single most important reason))*
1=Trains are overcrowded
2=Trains are not safe
3=Afraid car might be stolen
4=Trains have slower journey times
5=Current transport is cheaper
6=Private transport provides more flexibility
7=Do not know where to get info on the train service
8=Was not aware that there are secure park-and-ride facilities
9=Other (specify)

ANNEXURE E: Vehicle registration number plate recording template

DEPARTMENT OF COMMUTER SAFETY
COMMUTER SAFETY PROGRAMME

CAR PARKING CONTROL SHEET

STATION: _____ WEEK: _____

VEHICLE REGISTRATION NUMBER	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
TOTAL NUMBER OF VEHICLES					

SIGNATURE OF VOLUNTEER: : _____

INITIAL AND SURNAME: : _____

ANNEXURE F: Vehicle registration number plate database fields and codes

The data collected through the vehicle registration number plate recording template was built into a database (figure F.1) by listing the week when the data was collected, the station at which the data was collected, the vehicles registration number and the days that the vehicle was parked at the park-and-ride facility. A coding of “1” was used to indicate if the vehicle used the park-and-ride facility for that specific day. A coding of “2” was used to indicate that the vehicle did not use the park-and-ride facility for that specific day, and a coding of “3” was used if the form indicated that there was a vehicle parked at the park-and-ride facility that week but no data was indicated of the vehicles usage for that day.

Figure F.1: Example of vehicle registration number plate database 1

Week	Station	Vehicle registration number	Monday	Tuesday	Wednesday	Thursday	Friday
6 July till 10 July	Brackenfell	CBS 40774	1	1	1	2	1
13 July till 17 July	Brackenfell	CBS 40774	2	2	1	1	2
13 July till 17 July	Brackenfell	CF 111 570	1	2	1	2	1
20 July till 24 July	Brackenfell	CBS 40774	1	2	1	1	1
20 July till 24 July	Brackenfell	CF 111 570	1	1	2	2	1
20 July till 24 July	Brackenfell	CY 20589	2	1	1	1	2

The database was then used to search for the same vehicle at other park-and-ride facilities to assess if negative lot competition is present. Through this the variation of vehicle usage between stations in the before, during and after park-and-ride facility construction period is shown.

The data in this database can then be pivoted to construct a second database (figure F.2) to run analysis to find the utilisation of the park-and-ride facilities per day (before, during and after construction), the average frequency of usage per week of vehicles at the park-and-ride facility and the breakdown of users per week at the park-and-ride facility.

Figure F.2: Example of vehicle registration number plate database 2

Vehicle registration number	06-Jul-09	07-Jul-09	08-Jul-09	09-Jul-09	10-Jul-09	11-Jul-09	12-Jul-09	13-Jul-09	14-Jul-09	15-Jul-09	16-Jul-09	17-Jul-09	18-Jul-09	19-Jul-09	20-Jul-09	21-Jul-09	22-Jul-09	23-Jul-09	24-Jul-09
CBS 40774	1	1	1	2	1			2	2	1	1	2			1	2	1	1	1
CF 111 570								1	2	1	2	1			1	1	2	2	1
CY 20589															2	1	1	1	2

ANNEXURE G: Ethics form submitted for intercept surveys approval

EBE Faculty: Assessment of Ethics in Research Projects

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (**Zulpha.Geyer@uct.ac.za**; Chem Eng Building, Ph 021 650 4791). Students must include a copy of the completed form with the thesis when it is submitted for examination.

Name of Principal Researcher/Student: **Johann van Rensburg**

Department: **Civil Engineering, Centre for Transport Studies**

If a Student: Degree: **MPhil Transport Studies (120 credit diss.)** Supervisor: **A/Prof Roger Behrens**

If a Research Contract indicate source of funding/sponsorship: **Scholarship received from NDOT/UNDP-GEF 2010 Sustainable Transport Project**

Research Project Title: **Measuring and analysing the impacts of travel demand management interventions on travel behaviour: The case of Rail-based Park-and-Ride facilities in the City of Cape Town.**

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	**NO**
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	**YES**
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	**NO**
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	**NO**

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	**Johann, Andre van Rensburg**	**23/04/2010**

This application is approved by:

Supervisor (if applicable):	**A/Prof Roger Behrens**	**23/04/2010**
HOD (or delegated nominee): Final authority for all assessments with NO to all questions and for all undergraduate research.		05/05/10
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.		24/5/10

ADDENDUM 1:
Please append a copy of the research proposal here, as well as any interview schedules or questionnaires:

Appended to this document:

1. **Dissertation proposal**
2. **Intercept survey questionnaire of Park-and-Ride users**
3. **Intercept survey questionnaire of Park-and-Ride non-users**

ADDENDUM 2: To be completed if you answered YES to Question 2:

It is assumed that you have read the UCT Code for Research involving Human Subjects (available at http://web.uct.ac.za/depts/educate/download/uctcodeforresearchinvolvinghumansubjects.pdf) in order to be able to answer the questions in this addendum.

2.1 Does the research discriminate against participation by individuals, or differentiate between participants, on the grounds of gender, race or ethnic group, age range, religion, income, handicap, illness or any similar classification?	**YES**
2.2 Does the research require the participation of socially or physically vulnerable people (children, aged, disabled, etc) or legally restricted groups?	**NO**
2.3 Will you not be able to secure the informed consent of all participants in the research? (In the case of children, will you not be able to obtain the consent of their guardians or parents?)	**NO**
2.4 Will any confidential data be collected or will identifiable records of individuals be kept?	**YES**
2.5 In reporting on this research is there any possibility that you will not be able to keep the identities of the individuals involved anonymous?	**NO**
2.6 Are there any foreseeable risks of physical, psychological or social harm to participants that might occur in the course of the research?	**NO**
2.7 Does the research include making payments or giving gifts to any participants?	**NO**

If you have answered YES to any of these questions, please describe below how you plan to address these issues:

2.1 Data will be collected from respondents who use selected Park-and-Ride facilities, and from respondents who do not. This is required to fulfil the objectives of the research. There will be no discrimination in the selection of respondents on any other grounds.

2.3 Each interview will start with an explanation of the research purpose ("This survey is part of a Master dissertation research project at the University of Cape Town, which will collect information on the impact Park-and-Ride facilities at railway stations have on commuter travel behaviour. We would like to ask you some questions which should take around 10 minutes. All the information collected will be treated confidentially. May I proceed?"), and will only be conducted if the respondent gives his or her explicit consent.

2.4 No information will be asked or kept that can directly link the respondent to the data he/she provided in the captured dataset. Only information on residential streets will be asked and kept, but this data will only be available to the researcher and the supervisor. The participant will have full control if they want to disclose any such information. This information is needed to plot the catchment area of Park-and-Ride facilities in which the participants live. No data that may indicate the home location of the participants will be made available to any other parties or published in either the dissertation or any other publications.

ANNEXURE H: Permission letter: City of Cape Town

Address: Civic Centre	dilesi: Civic Centre	Adres: Civic Centre
10th Floor	10th Floor	10th Floor
4 Bay Side	4 Bay Side	4 Bay Side
P O Box 16548	Ibhoksi 16548	Posbus 16548
Vlaeberg 8018	Vlaeberg 8018	Vlaeberg 8018

Tel: +27 21 400 4717 **Umnxeba: +27 21 400 4717** **Tel: +27 21 400 4717**
Fax: +27 21 400 4931 Ifeksi: +27 21 400 4931 Faks: +27 21 400 4931

E-Mail: niki.covary@capetown.gov.za

24 May 2009

Centre for Transport Studies
c/o Department of Civil Engineering
Private Bag x3
Rondebosch
7701

Attention: Mr Johann van Rensburg

PERMISSION TO UNDERTAKE SURVEYS AT PARK AND RIDE STATIONS

The City of Cape Town has identified a number of Travel Demand Management (TDM) strategies for implementation. One of which is the establishment and upgrade of rail based Park & Ride facilities, which aims to meet both everyday commuter and 2010 World Cup travel demands. The Park and Ride project is currently underway and it is anticipated that construction be completed by the end of the year.

The City of Cape Town supports the research currently being undertaken by Mr van Rensburg of the University of Cape Town, which is funded by the NDOT/UNDP-GEF 2010 Sustainable Transport Project. The research will comprise the measurement and analysis of the impacts of TDM interventions on travel behaviour, with a specific focus on rail based Park and Ride facilities in Cape Town. As systematic monitoring and assessment of the impacts of the interventions implemented are important in order to understand the effects on travel behaviour, permission is granted for surveys to be undertaken at the various Park and Ride stations. The survey data collected will provide critical information on why/ when and how commuters make travel decisions, which is essential for this research to be completed successfully.

Should you have any queries regarding this please do not hesitate to contact me on (021) 400 4717 or 084 403 0874.

Yours faithfully

NIKI COVARY

SENIOR PROFESSIONAL OFFICER: SUSTAINABLE TRANSPORT PLANNING